1964

BUICK CHASSIS SERVICE MANUAL *

LESABRE · WILDCAT · ELECTRA 225 · RIVIERA

4400 4600 4700 4800

1 9 6 4

BUICK CHASSIS SERVICE MANUAL

For 4400, 4600, 4700 and 4800 Models

This service manual furnishes chassis service information on 1964 Buick 4400, 4600, 4700 and 4800 Models. The information applies equally to all models except where a difference is indicated by specifying a particular model or series.

ATTENTION IS DIRECTED TO THE INTRODUCTION on page 0-1 which describes the arrangement of this manual and how it should be used to locate desired information.

GENERAL MOTORS PRODUCTS OF CANADA LTD.

OSHAWA, ONTARIO, CANADA

GROUP INDEX

LITHO IN CANADA

GROUP 0
INTRODUCTION—GENERAL INFORMATION

CONTENTS OF GROUP 0

This manual is divided into major Groups, Sections, and Paragraphs as explained below. The purpose of this arrangement is to bring related subjects closely together in accordance with the usual methods of performing service operations, and consequently to present information in a logical and easily understood order.

Any desired subject in this manual may be located by reference to the alphabetical index at back of manual.

Any desired subject also may be located by turning to the first page of the appropriate Group where contents of the Group are listed. Where the Group is divided into Sections the first page of each Section lists the contents of the Section.

1. **GROUPS.** The manual is divided into the consecutively numbered major Groups shown on the preceding title page. To locate the first page of a Group, bend the manual until the black tab on first page of group can be seen in line with the Group title on title page.

The first page lists the contents of the Group.

2. **SECTIONS.** Large Groups are divided into appropriate Sections as shown on first page of the group. Sections bear the Group number and letters A, B, C, etc., in alphabetical order.

The first page of each Section lists the contents of section.

3. **PARAGRAPHS.** Each Group is divided into appropriate Paragraphs which are numbered consecutively within the Group, whether or not the group is divided into sections.

Paragraph titles and page numbers are listed on the first page of each Section if used, or on first page of the Group if sections are not used.

4. **SUB-PARAGRAPHS.** Where necessary for clarity, or distinction between models, Paragraphs are divided into appropriately titled Sub-paragraphs. These are usually lettered in alphabetical order within the paragraph.

5. **PAGE AND ILLUSTRATION NUMBERS.** Pages and illustrations are numbered consecutively within each Group. The number consists of the Group number followed by the Page or Figure number. Page numbers are printed in the upper outer corners of all pages.

6. **CROSS REFERENCES.** All references to information in other parts of manual are made by Paragraph Number, to avoid the necessity of first referring to the alphabetical index for location. Paragraph references are usually given in parentheses, for example: (par. 7-15) refers to the 15th paragraph in Group 7, "Chassis Suspension".

7. **SPECIAL TOOLS.** Unless otherwise indicated, all special tools identified by tool numbers in the manual are available through Kent-Moore Organization, Inc., 28635 Mound Road, Warren, Michigan.

1964 BUICK MODELS

Series	Body Styles	Wheel Base
	LeSabre	
4439	4-Dr. 4-Window Hardtop	123"
4447	2-Dr. 4-Window Pillarless Coupe	123"
4467	2-Dr. 4-Window Convertible	123"
4469	4-Dr. 4-Window Thin Pillar Sedan	123"
4635	4-Dr. 2-Seat Station Wagon	123"
4645	4-Dr. 3-Seat Station Wagon	123"
	Wildcat	
4639	4-Dr. 4-Window Hardtop	123"
4647	2-Dr. 4-Window Pillarless Coupe	123"
4667	2-Dr. 4-Window Convertible	123"
4669	4-Dr. 4-Window Thin Pillar Sedan	123"
	Riviera	
4747	2-Dr. 4-Window Pillarless Coupe	117"
	Electra 225	
4819	4-Dr. 6-Window Thin Pillar Sedan	126"
4829	4-Dr. 6-Window Pillarless Sedan	126"
4839	4-Dr. 4-Window Hardtop	126"
4847	2-Dr. 4-Window Pillarless Coupe	126"
4867	2-Dr. 4-Window Convertible	126"

IDENTIFICATION NUMBERS

The vehicle identification number is embossed on a serial number plate attached to the left front body hinge pillar. The first digit of the number indicates the series.

4 - 4400 7 - 4700
6 - 4600 8 - 4800

The second digit is the letter "K" representing the year 1964. The third digit is a number indicating the assembly plant at which the car was built.

1 - Flint 5 - Wilmington
2 - South Gate 6 - Atlanta
4 - Kansas City, Ka.

The remaining group of 6 digits is the individual car serial number. This number is also stamped on the engine crankcase just forward of the right cylinder head and constitutes the legal engine number.

An engine production code number is also stamped on the engine. This number is stamped alongside the vehicle identification number, but is upside down when viewed from the front of the engine. The engine production code number, along with the vehicle identification number, is used to identify the engine on product reports, etc.

The production code numbers are prefaced as follows for 1964:

KL	300 Cu. In. V-8 Standard
KM	300 Cu. In. V-8 Standard (Export)
KP	300 Cu. In. V-8 High Performance
KT	401 Cu. In. V-8 Standard
KV	401 Cu. In. V-8 Export
KW	425 Cu. In. V-8 With 1-4 Barrel
KX	425 Cu. In. V-8 With 2-4 Barrels

SPECIFICATIONS

All Models Exc. 4747

Front Tread . . . . 62.0"
Rear Tread . . . . 61.0"
Width - Overall . . . . 78.0"

4400 - 4600

Length - Overall . . . . 218.8"
Height - Overall - 4400 . . . . 56.4"
Height - Overall - 4600 . . . . 55.6"

4747 - Riviera

Length - Overall . . . . 208.0"
Height - Overall . . . . 53.0"
Width - Overall . . . . 76.6"
Front Tread . . . . 60.0"
Rear Tread . . . . 59.0"

4800 - Electra 225

Length - Overall . . . . 222.8"
Height - Overall . . . . 57.0"

IDENTIFICATION NUMBERS

U. S. PRODUCTION

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6 - 4600	8 - 4800

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The production code numbers are prefaced as follows for 1964:

KL	300 Cu. In. V-8	Standard
KM	300 Cu. In. V-8	Standard (Export)
KP	300 Cu. In. V-8	High Performance
KT	401 Cu. In. V-8	Standard
KV	401 Cu. In. V-8	Export
KW	425 Cu. In. V-8	With 1-4 Barrel
KX	425 Cu. In. V-8	With 2-4 Barrels

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Height - Overall	57.0"

GROUP 1

MAINTENANCE

SECTIONS IN GROUP 1

SECTION 1-A

LUBRICARE INSTRUCTIONS

CONTENTS OF SECTION 1-A

1-1 ENGINE OIL RECOMMENDATIONS

a. Engine Oil

Engine crankcase oils have a definite effect on ease of starting, oil economy, combustion chamber deposits and engine wear. It is recommended that you use an oil which, according to the label on the can, is: (1) intended for service MS and (2) passes car makers' tests or meets General Motors Standard GM 4745-M. Oils conforming to these types contain detergent additives.

b. Grade or Viscosity

The grade or viscosity (SAE number) of engine oil should be selected for the lowest anticipated temperature at which cold engine starting will be required as recommended in the temperature-viscosity chart below.

c. Engine Oil Change and Viscosity Recommendations

Anticipated Lowest Temperatures	Use S.A.E. Viscosity Number	Change Your Oil at Least
Above Freezing (+32°F.)	S.A.E. 10W-30 S.A.E. 20W S.A.E. 20	Every 60 days or 6,000* miles, whichever occurs first.
Below Freezing (+32°F.) (to 0°F.)	S.A.E. 5W-20 10W	Every 60 days or 6,000* miles, whichever occurs first.
Below 0°F.	S.A.E. 5W-20 S.A.E. 5W	Every 60 days or 6,000* miles, whichever occurs first.

*If there is danger of oil contamination by dust, water or other foreign material during very extreme driving conditions, then the oil should be changed more frequently than shown in the table. Your Authorized Buick Dealer is well qualified to advise you.

Oil level should be checked more frequently during the break-in period since somewhat higher oil consumption is normal until piston rings become seated.

The oil level should be maintained between the "Full" and "Add" marks on the gauge rod; each space between marks represents one quart. Do not fill above "Full" mark.

d. Oil Color

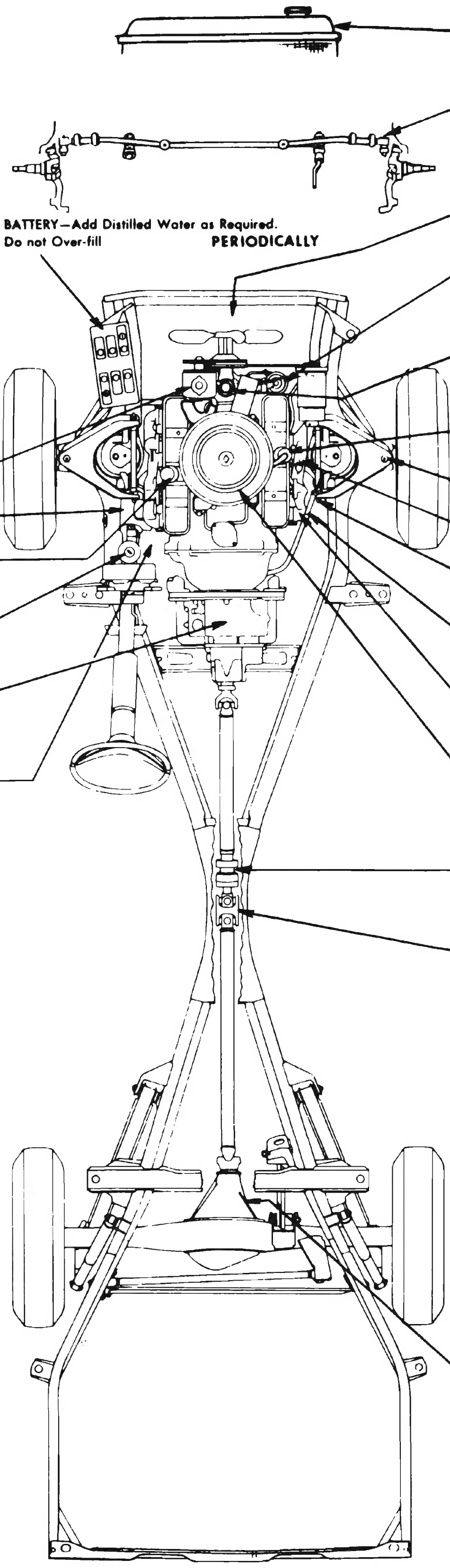
The color of "Service MS" type

1963 BUICK LUBRICATION CHART

4400 - 4600 - 4700 - 4800 SERIES

LUBRICANTS

- *CL* = Chassis Lubricant (Long Effectiveness - Buick Spec. 742*)
- *AT* = Automatic Transmission Fluid, Type A (Having AQ-ATF and identification number Suffix A embossed on lid of container)
- *EO* = Engine Oil (Current Viscosity) GM-4745-M*
- *HTL* = Buick Heat Trap Lube *
- *HBF* = Hydraulic Brake Fluid-Delco Super No. 11*
- *LUB* = Lubriplate
- *MPG* = Multi-Purpose Gear Lubricant (MIL-L-2105-B)
- *WBL* = Wheel Bearing Lubricant
- *TL* = Lube Conforming to Buick Specification No. 723*
- *EP* = Multi-Purpose Grease EP No. 1 Grade
- *MO* SAE 90 Multi - Purpose Gear Lube or SAE 40 or 50 Non Detergent Engine Oil Do not Use Lubes Containing *EP* Additives



RADIATOR—Maintain Coolant ½ Way Between Core & Tank Top — PERIODICALLY

LOWER STEERING KNUCKLE BALL JOINTS (2) —CL— 6,000 or 6 mos.

BATTERY—Add Distilled Water as Required. Do not Over-fill — PERIODICALLY

AIR CONDITIONER—Check Operation — ONCE A YEAR

OIL FILTER ELEMENT RECOMMENDATION Replace with Engine Oil Change Nearest 6,000 or 6 mos. Whichever Occurs 1st.

FUEL FILTER Replacement of Element Recommended — 24,000

POSITIVE CRANKCASE VENTILATOR - Replace Valve When Oil Filter Is Changed — 6,000

POWER STEER. RESERVOIR Check Oil Level Hot —AT— 6,000

UPPER STEERING KNUCKLE BALL JOINTS (2) —CL— 6,000 or 6 mos.

STD. STEERING GEAR—*MPG* Check Level — 6,000

ENGINE—CHECK OIL LEVEL—*EO*— PERIODICALLY

FILLER CAP —Wash and Re-oil Element —*EO*— 12,000

UPPER CONTROL ARM SHAFTS (4) 6,000 —CL— or 6 mos.

BRAKE MASTER CYLINDER—Maintain Level 1/8" Below Top of Reservoir Check Level —*HBF*— 6,000

AUTOMATIC TRANSMISSION—Check & Maintain Level-Hot—*AT*— 6,000; Clean Pan & Refill —*AT*— 24,000

SYNCHROMESH TRANSMISSION Maintain at Filler Opening - Flushing & Seasonal Changes Not Recommended - *MO* - 6,000

MANIFOLD VALVE SHAFT—Free Up —*HTL*— 6,000

ELECTRO CRUISE - Clean Power Unit Element 6,000

AIR CLEANER—Wash element in Kerosene—Re-oil. Squeeze out excess—*EO*— 12,000; 4700 - AIR CLEANER ELEMENT - Replacement Recommended 12,000

PROPELLER SHAFT SLIP SPLINE— Remove Plug lubricate and replace plug. —*EP*— 12,000

C/V JOINT BALL & Seat 4400 - 4600 - 4800 —*EP*— 6,000

STANDARD DIFFERENTIAL—REAR AXLE—Maintain at Filler Opening to ¼" below—Flushing & Seasonal Changes Not Recommended— —*MPG*— 6,000

For Complete Refill Use Only Factory Hypoid Gear Lubricant—Unless Axle in Service 1000 Miles or More Then Use -*MPG*-

POSITIVE TRACTION DIFFERENTIAL—REAR AXLE —Maintain at Filler Opening to ¼" below—Flushing & Seasonal Changes Not Recommended

Special Lube—Buick Spec. 723* Other Lubes may cause damage —*TL*- 6,000

CAPACITIES

Cooling System	
With Heater—Qts.	18 1/2
Without Heater—Qts.	17
Crankcase	
Refill—Qts.	4 (*5)
Dry Engine—Qts.	5 (*6)
*With Dry Oil Filter	
Gas Tank—Gal.	20
Rear Axle—Pts.	4 1/2
Automatic Transmission Refill—Qts.	12
Synchromesh Transmission - 3 Speed Pts.	3 1/2
Synchromesh Transmission - 4 Speed Pts.	2 1/2
Manual Steering Gear—Oz.	11
Power Steering Hydraulic System—Pts.	3

* Equivalent Acceptable if Meeting Specifications

Figure 1-1—Chassis Lubrication Chart

oil does not indicate its condition since it normally becomes dark (black or gray) after only a few hundred miles of driving. This is because the detergent content envelopes and holds in suspension extremely fine but harmless soot (soft carbon) and lead particles. The oil filter element does not remove this harmless material but it does remove harmful particles such as road dust, metal chips and hard carbon.

e. Crankcase Flushing

Flushing the crankcase with oils or solutions other than a good grade of 10-W engine oil is not recommended. When flushing to remove contamination appears advisable, use 3 quarts 10-W oil (4 quarts if filter is drained) and idle the engine at 1000 RPM (equivalent to 20 MPH) until the oil is hot, then drain crankcase and oil filter immediately after stopping engine. Fill crankcase with correct quantity and seasonal grade of oil. Install new oil filter element.

f. Use of Buick HD Concentrate

Buick HD Concentrate, available through Buick Parts Department under Group 1.850 is a compound of the materials used by oil refiners to manufacture high detergency motor oils. It is intended for use in engines operating under aggravated conditions where engine deposits, rust and corrosion cannot be adequately retarded by motor oils readily available to the average motorist. It is especially recommended for engines operated under restricted conditions such as frequent stops, short trips and slow speeds where such symptoms as sticking valves, valve lifters and rings are noticed.

Although HD Concentrate may be used continually it is normally unnecessary to use it with every crankcase refill. When used, the instructions on the container should be carefully observed.

1-2 MAINTENANCE—PERIODICALLY WHILE VEHICLE IS BEING REFUELED

a. Battery

Check level. If necessary add distilled water to bring level to split ring at bottom of filler wells.

NOTE: Do not overfill. Clean top of battery; if wet with acid, neutralize with soda and wash clean. See Figure 1-2.

b. Tires

For maximum tire life with corresponding softness of ride, maintain the recommended tire pressures:

Le Sabre	Front	22*
7:10 x 15 Tires	Rear	24
Le Sabre	Front	22*
7:60 x 15 Tires	Rear	24**
Wildcat	Front	24
7:60 x 15 Tires	Rear	24
Wildcat	Front	24
8:00 x 15 Tires	Rear	24
Riviera	Front	24
7:10 x 15 Tires	Rear	24
Riviera	Front	24
7:60 x 15 Tires	Rear	24
Electra 225	Front	24
8:00 x 15 Tires	Rear	24

*24 lbs. on air conditioned cars.
**Rear tires on Estate Wagons should be inflated 4 lbs. higher than the above recommendations.

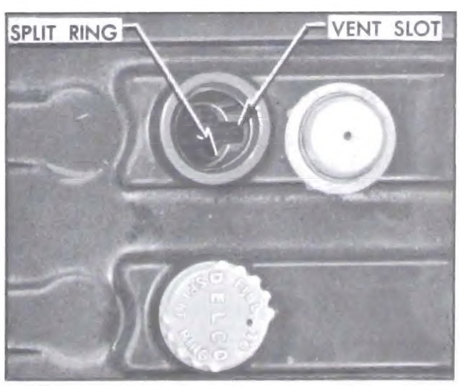


Figure 1-2—Battery Filler Well

Tire pressures should be checked and corrected only when the car has been standing at least 3 hours or driven less than 1 mile. This insures that the air in the tires is cold and not expanded by heat generated by driving. This is important since tires do increase in pressure as much as 7 lbs. when warm. Because it is almost impossible to estimate how much warm tires have increased in pressure, any attempt to compensate for this increase can result in inaccurate pressures.

Since the ability of a tire to carry heavy loads is directly proportional to its air pressure, it is important that the tire pressure be increased when carrying trunk loads of 200 lbs. or greater for long distances. Load distribution is primarily on the rear tires so only the rear tires need be given additional air pressure when hauling light trailers, vacationing with excessive luggage, or carrying heavy loads of any sort.

NOTE: Tire pressure should never exceed 32 psi cold.

c. Radiator Coolant

Radiator coolant level should be checked when the engine is cold if at all possible. If the radiator cap is removed when the system is at normal operating temperature the coolant will boil and spurt out due to the release of pressure. Coolant lost in this manner must of course be replaced. If coolant should be needed, fill radiator to approximately 1" below filler neck when cold. Do not overfill as loss of coolant due to expansion will result.

d. Engine Oil

This check should be performed last to allow the oil to drain back into the pan. Adding oil between changes may be necessary but only if the level is below the

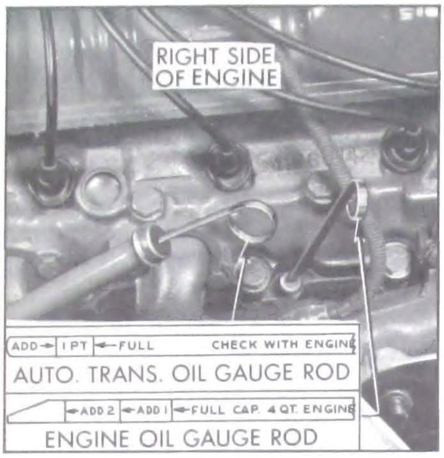


Figure 1-3—Engine and Automatic Transmission Oil Gauge Rods

"add oil" mark on the dip stick. See Figure 1-3.

NOTE: Oil level should only be checked when the engine is warm as cold oil drains back to the oil pan very slowly.

1-3 MAINTENANCE— EVERY 6,000 MILES

a. Engine Oil Change Recommendations

Drain and refill engine crankcase every 60 days or 6,000 miles, whichever occurs first. See paragraph 1-1.

b. Engine Oil Filter Change Recommendations

Replace engine oil filter with the engine oil change which comes nearest 6,000 miles or 6 months, whichever occurs first.

To change, screw filter off the filter base and discard. Wipe the gasket area of the base clean and install a new gasket in the groove of a new AC type PF-7 filter, or equivalent. Lubricate the gasket and screw the filter on the nipple of the base until the gasket just touches the base, tighten filter 2/3 turn more. Start engine.

Do not accelerate engine beyond normal idle until oil pressure is

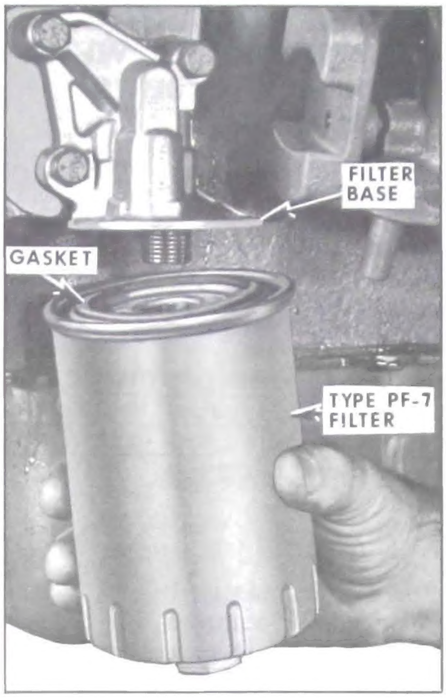


Figure 1-4—Oil Filter Installation

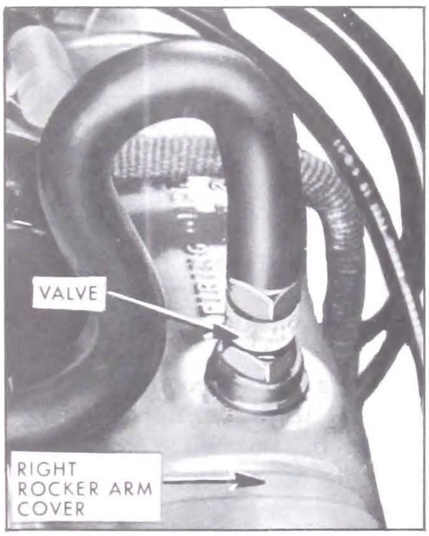


Figure 1-5—Positive Crankcase Valve

indicated. Check filter area for leaks after engine has run for five (5) minutes. See Figure 1-4.

c. Positive Crankcase Ventilator Valve

At each oil filter change it is recommended that the positive crankcase ventilator valve be replaced with the correctly calibrated valve. The correctly calibrated valve for the 4400, 4600, 4700 and 4800 Series is listed under Group 1.745, Part 6418754 in the Buick Parts Book. See Figure 1-5.

d. Front Suspension and Steering Linkage

The Buick front suspension has been lubricated with a long-effectiveness lubricant at the factory and should be re-lubricated with a long-effectiveness lubricant equivalent to Buick Specification No.742 every 6,000 miles or six months whichever occurs first.

NOTE: If lubricants not intended for long-effectiveness application are used, the lubrication interval should be shortened and should not exceed 2,000 miles.

Wipe dirt from the lubrication fittings and apply the lubricant under pressure at the following points (Figure 1-1):

Upper Control Arm Shafts (4 fittings)
Upper Ball Joints (2 fittings)
Lower Ball Joints (2 fittings)
Steering Linkage (4 fittings)

e. Manifold Valve Shaft

Place a few drops of "Buick Heat Trap Lube" or equivalent on shaft

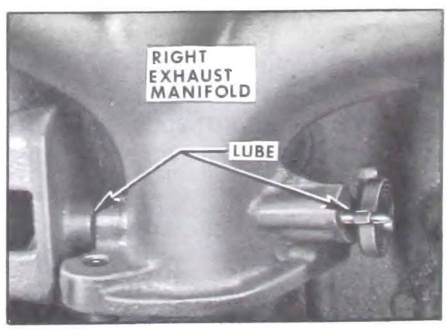


Figure 1-6—Manifold Valve

at each end and rotate shaft to work lubricant into bearings. See Figure 1-6. Buick Heat Trap Lube is available through Buick Parts Warehouses under Group 8.800.

f. Check Fluid Level

1. Brake Master Cylinder. On both manual and power brake jobs, the reservoir is under hood on left side. (On dash panel.)

Thoroughly clean filler cap nut before removal to avoid getting dirt into reservoir. Add fluid as required to bring level to 1/8" below top of filler opening. Use Delco Super No. 11 Hydraulic Brake Fluid or equivalent. Never use reclaimed fluid, mineral oil or brake fluids inferior to S.A.E. standard 70-R-1. See Figure 1-7.

2. Synchromesh Transmission. Check oil level, after allowing time for oil to settle. Clean the surrounding area before removing filler plug. Level should be maintained at filler plug opening by adding S.A.E. 90 Multi-Purpose Gear Lubricant or S.A.E. 40 or 50 Engine Oil. NOTE: Draining and flushing transmission are not necessary unless the lubricant has become contaminated.

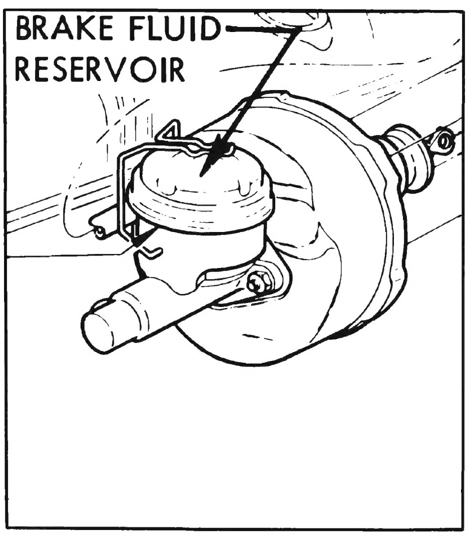


Figure 1-7—Brake Fluid Reservoir

3. Automatic Transmission. Check transmission oil lever, with transmission oil at operating temperature (180° approximate), transmission in park and engine idling.

Remove gauge rod located under right side of hood, see Figure 1-1, wipe dry with clean cloth, then reinstall to full depth. Remove rod and note oil level.

If oil level is below the "ADD" mark on gauge rod, add oil specified in paragraph 1-6 but do not fill above the "FULL" mark. Distance between the "FULL" and "ADD" marks represents approximately one pint.

4. Manual Steering Gear. Clean adjacent area, then remove gear housing filler plug. Add lubricant only as required to bring level to bottom of filler opening, using S.A.E. 90 Multi-Purpose Gear Lubricant. Seasonal or periodic change of lubricant is unnecessary.

5. Power Steering Gear. Thoroughly clean dirt from reservoir cap on top of oil pump, then remove cap. With system warmed up, maintain level with Buick power steering gear fluid or equivalent. See Figure 1-8.

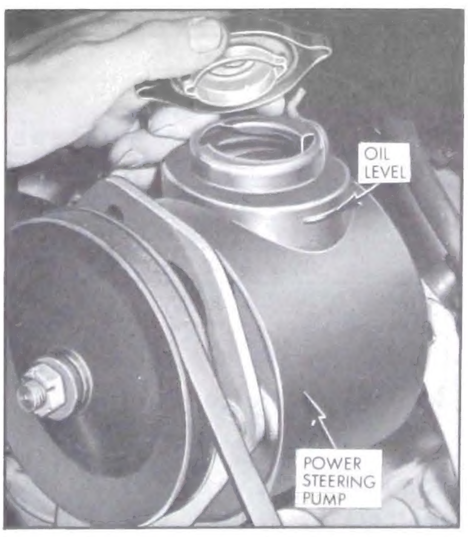


Figure 1-8—Power Steering Gear Reservoir

6. Rear Axle

(a) Standard Differential Rear Axle. Check lubricant level after allowing time for lube to settle. Clean the surrounding area before removing filler plug. Level should be maintained at filler plug opening to 1/4" below by adding S.A.E. 90 Multi-Purpose Gear Lubricant (MIL-L-2105B). When car is operated in temperatures continuously below - 10°F. use 80 Multi-Purpose Gear Lubricant.

NOTE: Draining and flushing is not recommended, unless the lubricant has become contaminated. When complete refilling is necessary, S.A.E. 80 or 90 Multi-Purpose Gear Lubricant may be used provided the axle has been in service for 1,000 miles or more. Axles with less than 1,000 miles must not be completely refilled with any lubricant other than Factory Hypoid Lubricant.

7. Positive Traction Differential Rear Axle. Identified by embossed tag on filler plug reading, "Use limited slip differential lube only". Check lubrication level after allowing time for lubricant to settle. Clean the surrounding area before removing filler plug. Level should be maintained at filler plug opening to 1/4" below by adding lubricant conforming to

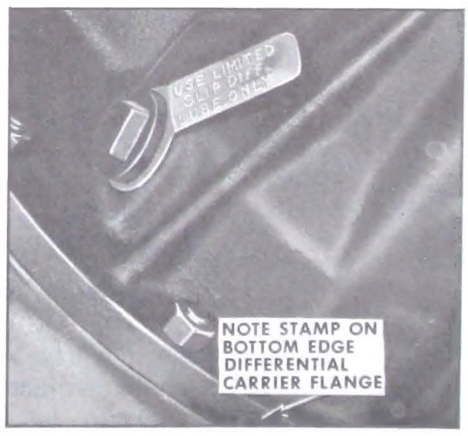


Figure 1-9—Identifying Positive Traction Differential

Buick specification #723 only, as specified in paragraph 1-9. See Figure 1-9.

NOTE: If Positive Traction Differential lube becomes contaminated, the axle assembly may be flushed with light engine oil and then refilled with Positive Traction Lube.

g. Minor Lubrication

Occasionally lubricate the pivot points of moving parts such as door and hood hinges and latches, door hold open, clutch, transmission, parking brake and folding top linkage with Lubriplate, or equivalent, or engine oil where applicable. A small quantity of lock lubricant occasionally applied to lock cylinders will prevent sticking. See details under Maintenance - As Required.

NOTE: Do not lubricate carburetor or throttle linkage.

h. Body Rubber Parts

Door, hood, and rear compartment rubber weatherstrips and bumpers, and door bottom drain hole sealing strips may be kept pliable and quiet by the application of a light coat of Buick 4-X Compound or suitable silicone lubricant equivalent.

i. Tires

For best tire mileage switch tires as recommended in paragraph 7-8

j. Constant Velocity Universal Joint Center Ball (4400-4600-4700-4800 Series)

Rotate propeller shaft until fitting is visible through rear hole in frame tunnel. See Figure 1-10. Insert special grease gun nozzle (Alemite #326375 or equivalent) through frame tunnel to bear solidly against fitting. One or two shots from a lever type grease gun are sufficient.

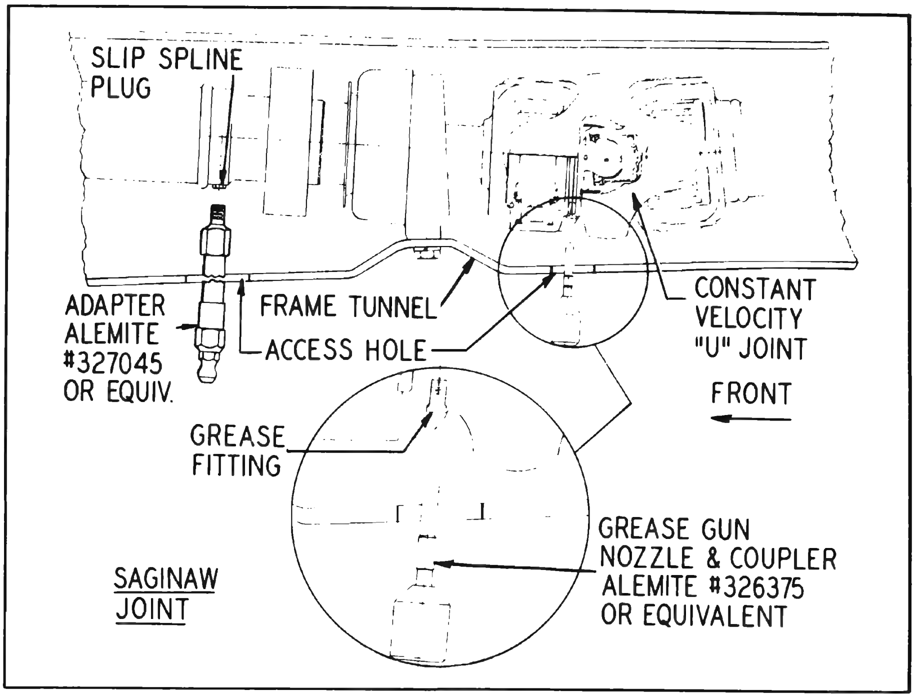


Figure 1-10—Propeller Shaft Slip Spline and Constant Velocity Universal Joint Lubrication Points

Lubricating the Constant Velocity joint on certain hoists such as the frame contact type can be difficult as they allow the axle to drop and thus move the CV joint grease fitting away from the access hole. To correct, either the axle must be raised or the propeller shaft disconnected from the rear companion flange. CAUTION: Reassembly of the propeller shaft should be carefully done as instructed in Section 06.

NOTE: Multi-Purpose Grease EP #1 grade is the only lubricant applicable at this point. Do not use ordinary chassis lube. EP #1 lube is available through many oil companies.

k. Electro-Cruise

Remove Electro-Cruise air filter element by bending back the four tabs on the power unit and removing the outer screen, element, and inner screen. See Figure 1-11.

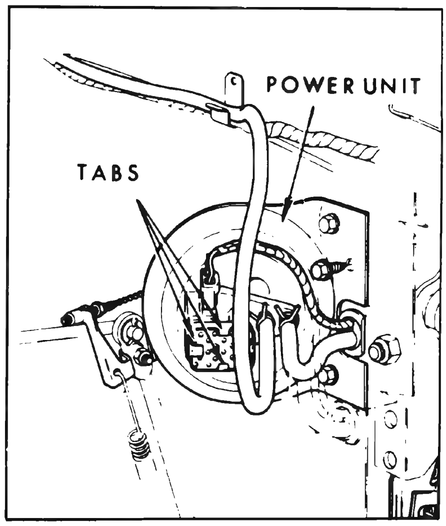


Figure 1-11—Electro-Cruise Power Unit

Clean the screens and element in a suitable cleaner such as kerosene. Squeeze cleaner out of the element. DO NOT OIL ELEMENT. Reinstall inner screen, filter, and outer screen in the power unit and reposition tabs to retain filter assembly.

1-4 MAINTENANCE— EVERY 12,000 MILES OR ONCE A YEAR

(Suggested in addition to the 6,000 mile recommendations)

a. Tune-Care

Tune-Care includes: Clean and/or replace spark plugs and ignition points; check compression, battery, cranking system, charging system, fuel pump, choke, hose connections, belts, carburetor; set engine timing and adjust idle speed.

b. Engine Air Cleaner (4400-4600-4800)

Recommendation is to normally service every 12,000 miles. If car is operated in dusty territory check condition of air cleaner element more frequently and clean if dirty.

To clean the element, carefully remove from the mesh support, wash in kerosene and squeeze out.

CAUTION: Take precautions against the possibility of fire. Do not wring the element or it may be torn. Wrap the element in a dry cloth and squeeze to remove all possible solvent.

Oil the element liberally with engine oil and squeeze to evenly distribute the oil through the element and remove excess.

NOTE: The element should be only damp with oil, not dripping.

Reinstall the element on the mesh support taking care to have the edges of the element over the support to affect a good seal. See Figure 1-13. Clean any oil or accumulated dirt out of the air cleaner housing before installing element.

NOTE: If the element becomes damaged replace with AC type A-96C or equivalent.

CAUTION: Take precautions against the possibility of fire by making certain element is drained dry of cleaner.

c. Engine Air Cleaner Element (4747)

Replacement of element is recommended every 12,000 miles, oftener under severe dust conditions. Service with AC Type 85-C or equivalent for maximum engine protection. Element must not be washed, oiled, tapped or blown with an air hose.

d. Crankcase Ventilator— Filler Cap

Every 12,000 miles (more often under dusty operating conditions) remove the oil filler cap and wash the filtering element in kerosene. Allow element to drain until dry. Oil the element with a light engine oil and reinstall cap.

e. Engine Belts

Inspect belts for cracks and for proper tension.

Figure 1-13—Installing Element On Support

f. Propeller Shaft Slip Spline

Each 12,000 miles, rotate propeller shaft so plug in propeller shaft is accessible through front hole in frame tunnel. See Figure 1-10. Remove plug and install grease fitting. Apply multipurpose grease EP #1 Grade. Do not use ordinary chassis lube. Remove grease fitting and reinstall plug. EP #1 lube is available through many oil companies.

NOTE: Special extended length grease fittings to make this operation simple and fast are available from lubrication equipment jobbers.

1-5 MAINTENANCE— EVERY 18,000 MILES

a. Brakes

Examine brake linings for wear, and the self-adjusting mechanism for proper functioning. Although linings may not be excessively worn, this check will indicate when another inspection should be made. If required, use Buick Factory Engineered replacement linings or equivalent. Lubricate the self-adjusting mechanism adjusting screw with Delco Moraine Special Brake Lubricant or equivalent.

b. Front Wheel Bearings

There is no periodic lubrication schedule for front wheel bearings. They may be relubricated whenever brake drums are removed. Always follow with the correct bearing adjustment as outlined in paragraph 7-10.

1-6 MAINTENANCE— EVERY 24,000 MILES

(Suggested in addition to the 6,000 and 12,000 mile recommendations)

a. Fuel Filter

Replacement of the disposable filter is recommended. More frequent replacement may be necessary if contaminants have entered the fuel system. Replace with filter type GF-94 or equivalent on non-air conditioned cars and type GF-96 or equivalent for air conditioned cars.

b. Automatic Transmission

At 24,000 mile intervals the transmission oil pan should be drained and removed and the screen should be removed and cleaned. The transmission should then be refilled with fresh oil. Transmission MUST NOT BE FLUSHED when oil is changed.

1. Approved Oils for Buick Automatic Transmission

The following oils are approved for Buick Automatic Transmission and no other fluid should be used:

Special Buick Oil available through Buick Parts Warehouses under Group 4.101.

Automatic Transmission Fluid, Type A, available through petroleum suppliers. This fluid must have AQ-ATF and identification number, suffix A embossed in lid of can.

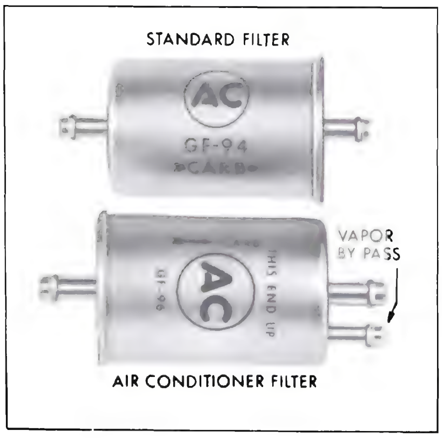


Figure 1-14—Fuel Filters

2. Re-fill Procedure

1. Remove 13 bolts attaching oil pan to case.

2. Remove oil screen and paper element.

3. Clean pan and screen with a suitable solvent.

4. After installing new paper element in oil screen, re-install oil screen on transmission. Use AC PF-160 or equivalent.

5. Install oil pan and bolts. Torque to 10-12 ft. lbs.

6. Fill transmission with 5 pints of transmission fluid. Start engine and allow to idle. DO NOT RACE ENGINE. Finish filling transmission until fluid level showing on gauge rod is within 1/2" of FULL mark.

1-7 MAINTENANCE—SEASONAL (Cooling System and Air Conditioner Services)

a. Coolant

Winter - A permanent glycol-type corrosion and anti-freeze cooling system protection solution should be used during the Winter months. The proper type corrosion protector and anti-freeze solution may be recognized by the information printed on the container which states "Meets General Motors Standard GM-1899-M". Your Buick dealer is qualified to advise you in the selection of the proper anti-freeze.

Summer - Clear water and Heavy Duty Cooling System Protector and Water Pump Lubricant or equivalent should be installed each Spring. Heavy Duty Cooling System Protector and Water Pump Lubricant is available through your Buick dealer under Part #980504. If any other cooling system protector is used, be certain it is labeled to indicate that it meets General Motors Specification GM 1894-M.

b. Air Conditioner-Equipped Models

It is recommended that the air conditioner be checked by your Buick dealer each Spring in preparation for Summer operation.

It is good practice to occasionally remove insects and dirt from the air conditioner condenser.

1-8 MAINTENANCE—AS REQUIRED

a. Body Lubrication

1. Front Door Hinge Hold-Open Assembly. Wipe off dirt and apply a light coat of Lubriplate or its equivalent at points indicated (Figure 1-16). The hinge pins should be lubricated with engine oil.

2. Door Lock Striker. Wipe off dirt and apply a thin coat of stick-type lubricant to top surface of lock bolt striker teeth (Figure 1-17). After lubrication, close door several times and remove excess lubricant along side edge of teeth.

3. Door Lock Rotary Bolt and Housing. Wipe off dirt and apply a thin coat of stick-type lubricant and oil (Figure 1-18).

4. Rear Door Hinge and Hold-Open Assembly. Wipe off dirt and apply a light coat of Lubriplate or equivalent, to frictional points (Figure 1-19). Wipe off excess lubricant.

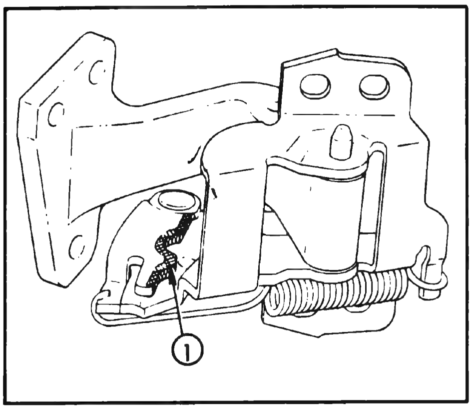


Figure 1-16—Front Door Hinge Hold-Open Assembly

5. Instrument Panel Compartment Door Hinge. Wipe off dirt and apply a sparing amount of dripless oil to the hinge frictional points. Operate door and wipe off excess lubricant.

6. Rear Compartment Lid and Tail Gate Locks. On rear compartment lid locks, apply a thin film of Lubriplate or its equivalent (Figure 1-20). On tail gate locks, apply a thin film of Lubriplate or its equivalent to the bolt at the striker contact areas.

7. Door and Rear Compartment Lock Cylinders. A small quantity of lock lubricant occasionally applied to the lock cylinders will prevent sticking.

8. Rear Compartment Lid Hinges and Torque Rods. Apply Lubriplate or equivalent, to hinge and torque rods at friction points.

9. Door Jamb Switch. Wipe off dirt and apply a thin coat of Lubriplate or equivalent to the end surface of switch plunger. Wipe off excess lubricant.

10. Gas Tank Filler Door Hinge. Apply a few drops of dripless oil to frictional points of door hinge. Work door several times and wipe off excess lubricant.

11. Tail Gate Hinge. Wipe off dirt and apply a small amount of dripless oil to frictional areas.

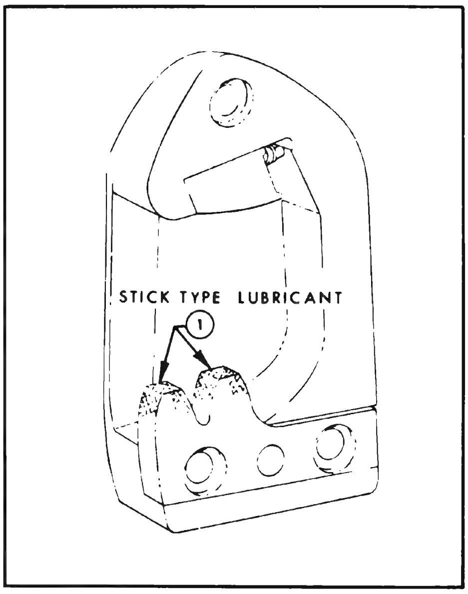


Figure 1-17—Door Lock Striker

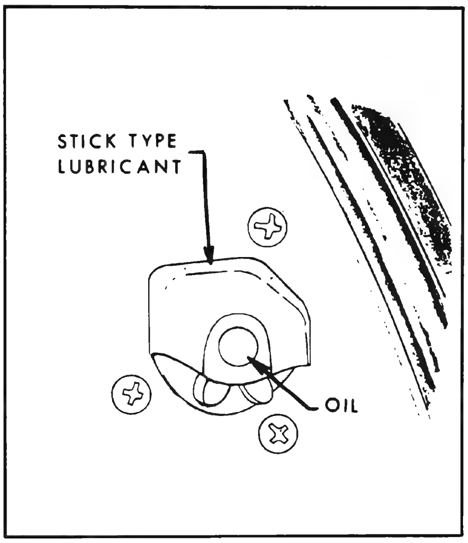


Figure 1-18—Door Lock Rotary Bolt and Housing

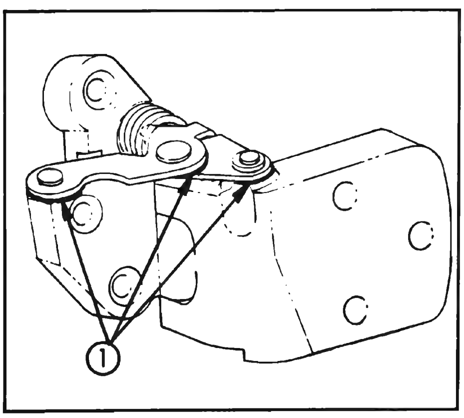


Figure 1-19—Rear Door Hinge and Hold-Open Assembly

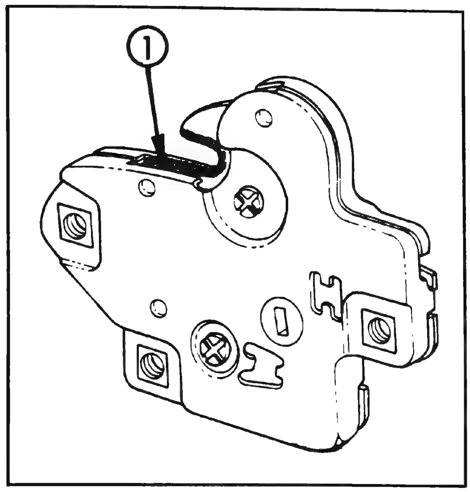


Figure 1-20—Rear Compartment Lid and Tail Gate Locks

12. Folding Seat Linkage. Wipe off dirt and apply a sparing amount of dripless oil to all frictional areas. Work linkage several times and wipe off excess lubricant.

13. Sunshade Rod. Remove sunshade assembly from support and apply a thin film of stick-type lubricant to end of sunshade rod (Figure 1-21). Wipe off all excess lubricant.

14. Folding Top Lift Cylinder Piston Rods. Twice each year, with folding top in raised position, wipe exposed portion of each top lift cylinder piston rod with a cloth dampened with brake fluid to remove any oxidation or accumulated grime. With another clean cloth, apply a light film of brake fluid to the piston rods to act as a lubricant.

NOTE: Use caution so that brake fluid does not come in contact with any painted or trimmed parts of the body.

15. Folding Top Linkage. Apply a sparing amount of light oil to all bearing points (Figure 1-22). Wipe off excess lubricant to prevent soiling trim.

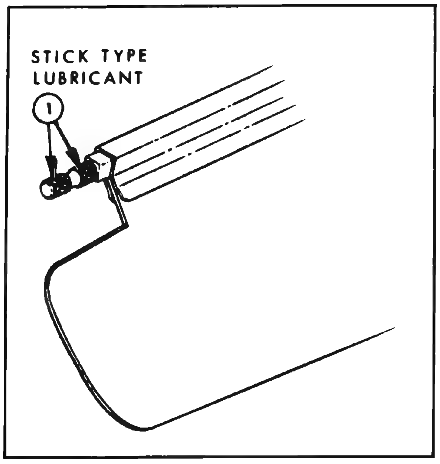


Figure 1-21—Sunshade Rod

16. Windshield Wiper Cams. Apply a small amount of silicone lube to both sides of cams. Wipe off excess.

b. Chassis Lubrication

1. Hood Latches and Hinges. Lightly coat hood guide, latches, lever, and dovetail bolts with Lubriplate or equivalent. Apply engine oil to hood hinge pins.

1-9 REAR AXLE LUBRICANT RECOMMENDATIONS

a. Standard Differential Axle

Buick standard rear axles are filled at the factory with a special hypoid gear lubricant. It is not necessary to remove the original lubricant at any time except when it has become contaminated, or when it is required for inspection of parts or for repairs. Therefore there is no drain hole in the rear axle housing.

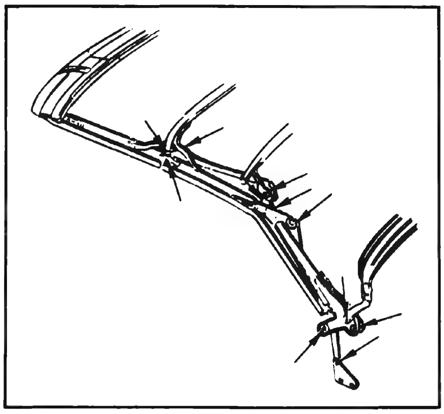


Figure 1-22—Folding Top Linkage

Draining and flushing is not recommended unless the lubricant has become contaminated. When complete refilling is necessary, Multi-Purpose Gear Lubricant (conforming to specification MIL-L-2105B) may be used provided the axle has been in service for 1,000 miles or more. Axles with less than 1,000 miles service must not be completely refilled with any lubricant other than Factory Hypoid Lubricant.

The lube is packaged with Replacement Ring and pinion gear sets and is also available through the Buick Parts Department under Group 5.535.

b. Positive Traction Differential Axle

Buick Positive Traction Differential Axles are filled at the Factory with a special lubricant conforming to Buick Specification No. 723. It is not necessary to remove the lubricant at any time except when it has become contaminated or when it is required for inspection of parts or for repairs. There is no drain hole in the rear axle housing.

In all cases of adding lubricant to bring to proper level or complete refilling of Positive Traction Rear Axle, only lubricant conforming to Buick Specification No. 723 should be used. Lubricant conforming to this specification may be obtained from any Buick Parts Warehouse under Group 5.535.

Positive Traction Differential Rear Axles can be identified by an embossed tag affixed to the rear axle filler plug which reads, "Use Limited Slip Differential Lube Only". Also, a letter "X" inside a letter "O" is stamped on the bottom of the differential carrier casting just forward of the rear axle housing and is visible from beneath the car. See Figure 1-9.

GROUP 2

ENGINE

SECTIONS IN GROUP 2

SECTION 2-A

ENGINE SPECIFICATIONS

CONTENTS OF SECTION 2-A

2-1 ENGINE TIGHTENING SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed, to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque Ft. Lbs.
Plug	Spark	14 MM	25-35
Plug	Crankcase Drain	1/2"-20	30-35
Bolt	Water Pump Cover	1/4-20	6-8
Bolt	Timing Chain Cover	5/16-18	20-25
Bolt	Lower Crankcase (Oil Pan)	5/16-18	6-15
Bolt	Valve Lifter Cover	5/16-18	3-5
Bolt	Valve Rocker Arm Cover	5/16-18	3-5
Bolt	Intake Manifold	3/8-16	25-30
Bolt	Exhaust Manifold	3/8-16	10-15
Bolt	Rocker Arm Shaft Bracket	3/8-16	30-35
Bolt	Water Manifold	3/8-16	25-30
Bolt	Generator Mounting Bracket	3/8-16	25-30
Nut	Connecting Rod Cap Bolt	3/8-24	40-45
Bolt	Flywheel to Crankshaft	7/16-20	50-60
Bolt	Cylinder Head	7/16-14	65-75
Bolt	Crankshaft Bearing Cap	1/2-13	100-110
Bolt	Harmonic Balancer	3/4-16	200 Min.

2-2 ENGINE GENERAL SPECIFICATIONS

NOTE: See paragraph 2-3 for dimensions.

	300 Cu. In.	401 Cu. In.	425 Cu. In.
Type - No. of Cylinders		90 Degree V-8	
Valve Arrangement		In Head	
Bore and Stroke	3.750" x 3.400"	4.1875" x 3.640"	4.3125" x 3.640"
Piston Displacement (cu. in.)	300	401	425
Compression Ratio	9.0 to 1	10.25 to 1	10.25 to 1
Export	7.6 to 1	8.75 to 1	
Compression Pressure @ 160 RPM Cranking Speed -			
Taxable Horsepower	45.0	56.11	59.51
Max. Brake Horsepower, Bare Engine - @ RPM	210 @ 4600	325 @ 4400	340 @ 4400
Engine Torque (lbs.-ft. @ RPM)	330 @ 2400	445 @ 4400	465 @ 2800
Octane Requirements			
Export		93 Research 84 Motor	
Power Pack		99 Research 88 Motor	
Manufacturing Code Number Preface (See Fig. 0-1)			
Firing Order	1-8-4-3-6-5-7-2	1-2-7-8-4-5-6-3	
Crankshaft Bearings No. and Type		5 Replaceable Liners	
Material		Steel Backed Babbitt	
Bearing Which Takes End Thrust		No Three	
Connecting Rod Bearings, Type		Replaceable liners	
Material	#5 M/100 Durex	First 4 M/400 Rear Durex 100A	
Piston Material		Cast Aluminum Alloy	
Compression Rings - Piston, Material	Cast Iron Lubrited	#1 Cast Iron Chrome -#2 Cast Iron Lubrited	
Oil Rings - No./Piston		One	
Type		3-Piece/Expander	
Location of all Piston Rings		Above Piston Pin	
Camshaft, Type and Material		Cast Alloy Iron	
Camshaft Drive		Chain	
No. & Type of Camshaft Bearings		5 Steel Backed Babbitt	
Valve Lifter Type and Material		Hydraulic, Iron Alloy	
Valve Spring Type		Dual Helical	
Oiling System Type		Forced Feed	
Oil Supplied to Bearing Surfaces -			
Crankshaft, Camshaft, Con. Rods		Full Pressure	
Pistons, Pins		Splash	
Cylinder Walls		Splash & Nozzle	
Valve Lifters, Rocker Arms, Valves		Low Pressure	
Normal Oil Pressure			
Oil Reservoir Capacity - Quarts			
Dry Engine		4 (5 with dry filter)	
Oil Filter, Make and Type		AC Type PF-7	
Cooling System Type		Pressure (15 lb. Rad. Cap)	
Water Temperature Control		Thermostat & Fixed By-Pass	
Thermostat Opens at - (deg. F)	170	180	
Cooling System Capacity - Quarts			
Less Heater	13.5	17	17
With Heater	15	18.5	18.5
Fan Diameter, No. of Blades, Regular		18.0"	
With Air Conditioning		20.0"	
Fan Drive - Regular		Water Pump Shaft	
With Air Conditioner		Torque and Temperature Sensitive Clutch	

2-3 ENGINE DIMENSIONS, FITS AND ADJUSTMENTS

NOTE: These dimensions and limits for fit of parts apply to new parts only. "T" means tight. "L" means loose.

Items	300 Cu. In.	401 Cu. In.	425 Cu. In.
Crankshaft Journal Diameter	2.2992"	2.2495	2.2495"
Crankshaft Journal to Bearing Clearance		.0005" - .0021"	
Crankshaft End Play at Thrust Bearing		.004" - .008"	
Crankpin Journal Diameter	2.000"	2.2495"	2.2495"
Crankpin Journal to Bearing Clearance	.0022"	.0002" - .0023"	
Connecting Rod End Play on Crankpin	.005" - .012" Total, Both Rods		
Connecting Rod Bearing Length		.820	
Cylinder Bores, Standard Size	3.750"	4.1875"	4.3125"
Piston Pin Diameter	.9394"	.9994" - .9997"	
Piston Pin Length	3.060"	3.520"	
Piston Pin Fit (In Connecting Rod)		.0007"T to .0015"T	
Piston Ring Cap, Compression Ring in Bore	.003" - .005"	.015" - .025"	
Oil Ring in Bore	.0095"	.015" - .055"	
Camshaft Bearing Journal Diam.			
No. 1		1.785" - 1.786"	
No. 2		1.755" - 1.756"	
No. 3		1.725" - 1.726"	
No. 4		1.695" - 1.696"	
No. 5		1.665" - 1.666"	
Valve Lifter Diameter		.8425"	
Valve Lifter Clearance in Crankcase		.0015 - .003"	
Valve Lifter Leakdown Rate, in Test Fixture		12 to 60 Sec.	
Rocker Arm Ratio		1.6 to 1	
Rocker Arm Clearance on Shaft	.0017" - .0032"	.0027" - .0042"	
Valve Head Diameter - Inlet	1.625"	1.875"	
Valve Head Diameter - Exhaust	1.3125"	1.500"	
Valve Seat Angle - Inlet & Exhaust		45 Degrees	
Valve Stem Diameter - Inlet	.3412" Top - .3407" Bottom	.373" Top - .3720" Bottom	
Valve Stem Diameter - Exhaust	.3407" Top - .3402" Bottom	.372" Top - .3715" Bottom	
Valve Stem Clearance in Guide - Inlet	.001" - .003" Top - .0015" - .0035 Bottom	.001" - .003" Top - .002" - .004" Bottom	
- Exhaust	.0015" - .0035" Top - .002" - .004 Bottom	.0015" - .0035" Top - .0025" - .0045 Bottom	
Valve Spring - Outer			
Valve Closed (lbs. @ length)	64 @ 1.640"	46 @ 1.600"	
Valve Open (lbs. @ length)	168 @ 1.260"	101 @ 1.160"	
Valve Spring - Inner			
Valve Closed (lbs. @ length)		25.5 @ 1.690"	
Valve Open (lbs. @ length)		76 @ 1.250"	

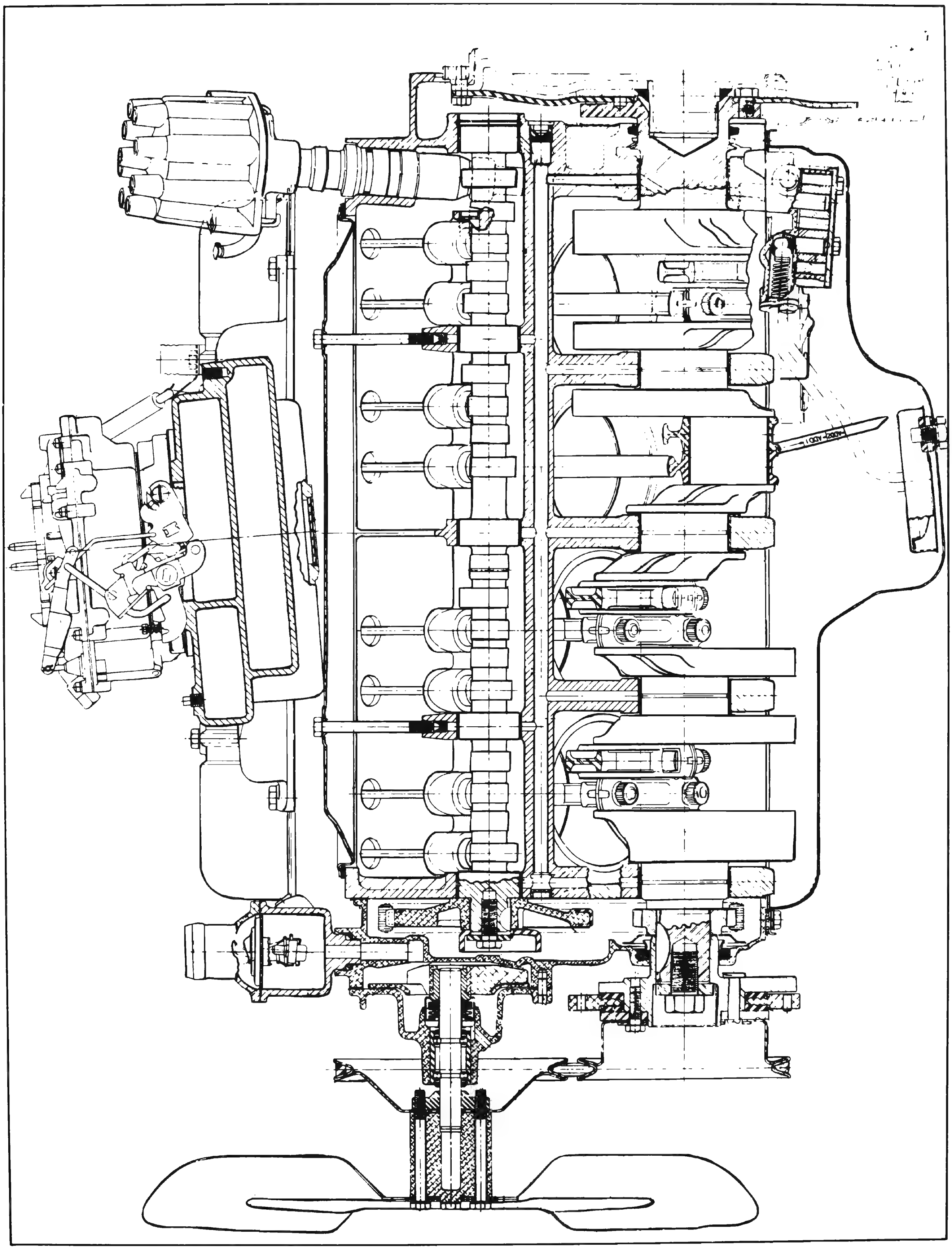


Figure 2-1—401 Cu. In. Engine Cross Sectional View

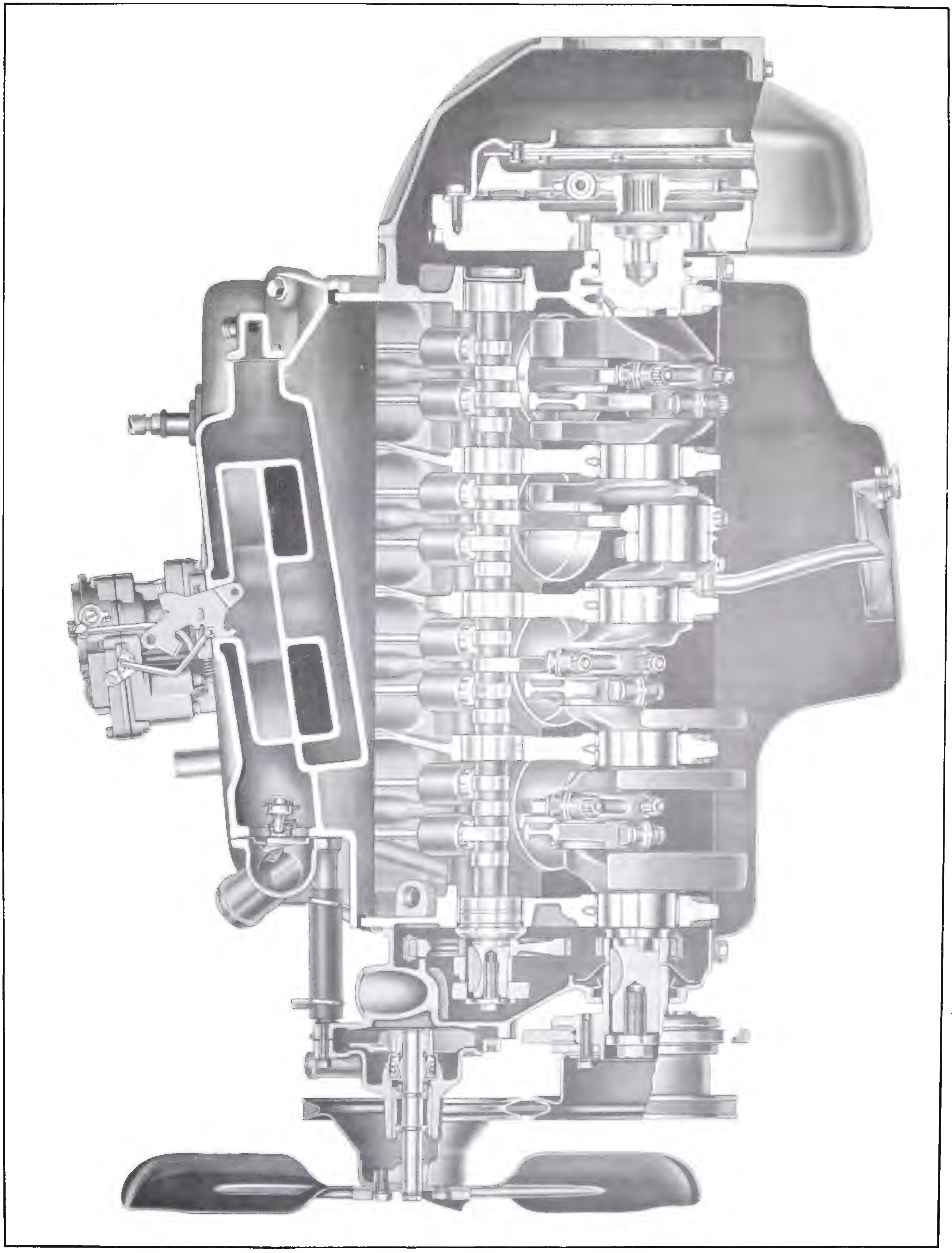


Figure 2-2—300 Cu. In. Engine Cross Section View

SECTION 2-B

ENGINE DESCRIPTION

CONTENTS OF SECTION 2-B

2-4 ENGINES AND MOUNTINGS

a. Engines in Each Series

Series	Engine Code # Prefix	Cu. In. Displacement	Use	Compression Ratio	Bore	Stroke	Carburetor	Horsepower	
								Taxable	Brake
4400	KL KP KR	300 300 300	Standard Optional Export	9.0 - 1 11.0 - 1 7.6 - 1	3.750 3.750 3.750	3.400 3.400 3.400	2 Bbl. 4 Bbl. 4 Bbl.	45.0 45.0	210 250
4600 4800	KT KV KX	401 401 425	Standard Export Optional	10.25 - 1 8.75 - 1 10.25 - 1	4.1875 4.1875 4.3125	3.640 3.640 3.640	4 Bbl. 4 Bbl. 2-4 Bbls.	56.11 59.51	325 315 360
4700	KW KX	425 425	Standard Optional	10.25 - 1 10.25 - 1	4.3125 4.3125	3.640 3.640	4 Bbl. 2-4 Bbls.	59.51 59.51	340 360

b. Engine and Transmission Mountings

The engine and transmission assemblies are supported in the frame on three synthetic rubber pads. One mounting pad is located on each side of the engine near the front end and approximately midway between top and bottom of the cylinder crankcase. The mounting pads are fastened between the crankcase and the cross member at front end of car frame. The front mountings are designed to support the weight of the engine and control its torsional characteristics.

The rear (transmission) mounting is located between the transmission rear bearing retainer and the transmission support.

2-5 ENGINE CONSTRUCTION (ALL ENGINES)

a. Cylinder Crankcase

The cylinder crankcase has two banks of four cylinders each, which form a 90 degree angle. The crankcase section extends below the centerline of the crankshaft to form a continuous flat surface with the rear bearing cap and the timing chain cover, permitting installation of the lower crankcase with a one-piece gasket. The upper portion of the flywheel housing is cast integral with the cylinder crankcase.

The right bank of cylinders (as viewed from rear) is set slightly forward of the left bank so that connecting rods of opposite pairs of cylinders can be connected to the same crankpin. Starting at front end, cylinders in the right bank are numbered 1-3-5-7 and cylinders in the left bank are numbered 2-4-6-8.

b. Crankshaft and Bearings

The crankshaft is supported in the crankcase by five steel-backed full precision type bearings, all having the same nominal diameter.

All bearings are identical except number three, which takes end thrust and rear main, which has a different width and material. See Figure 2-6.

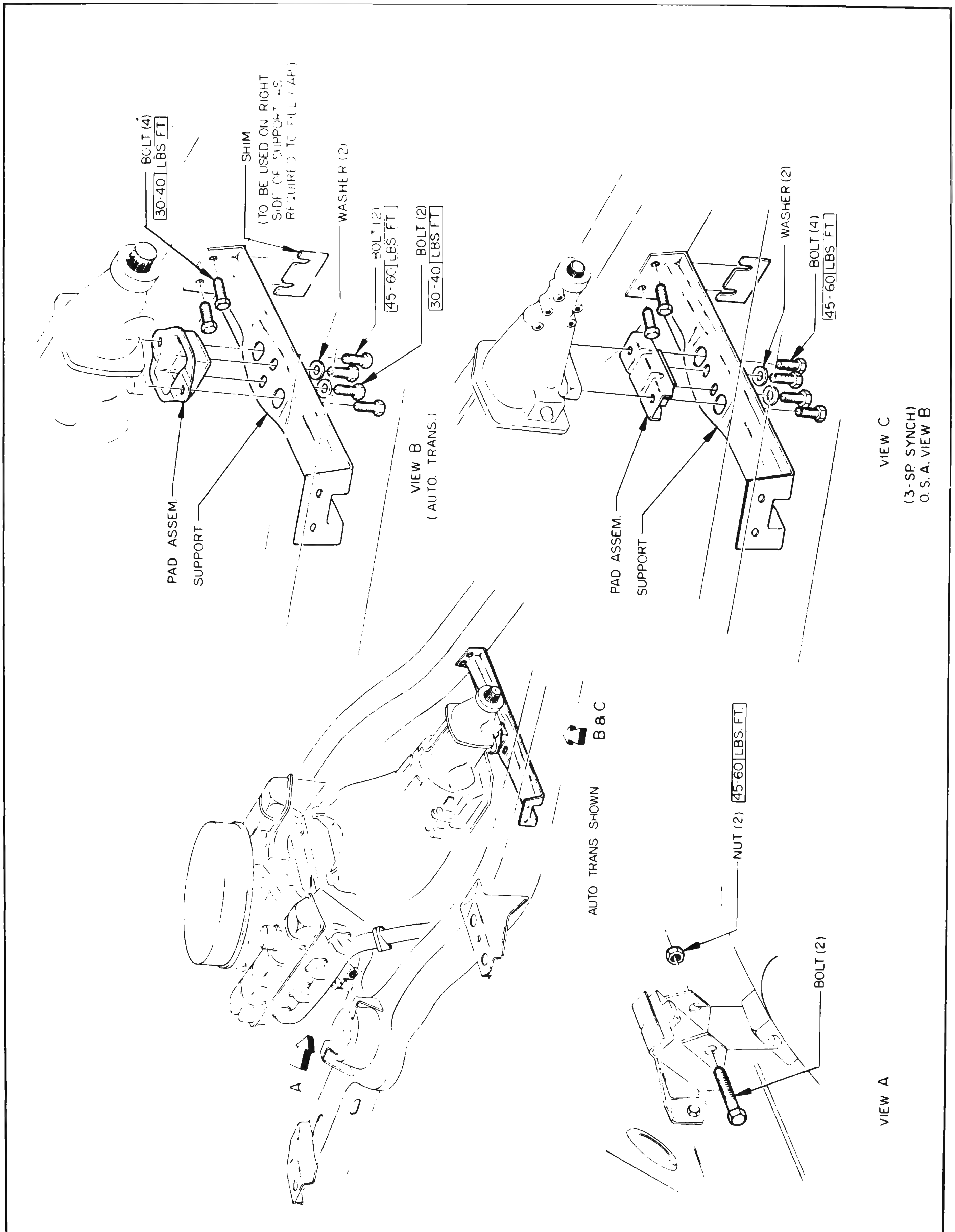


Figure 2-3—Engine and Transmission Mounting (4400 Series)

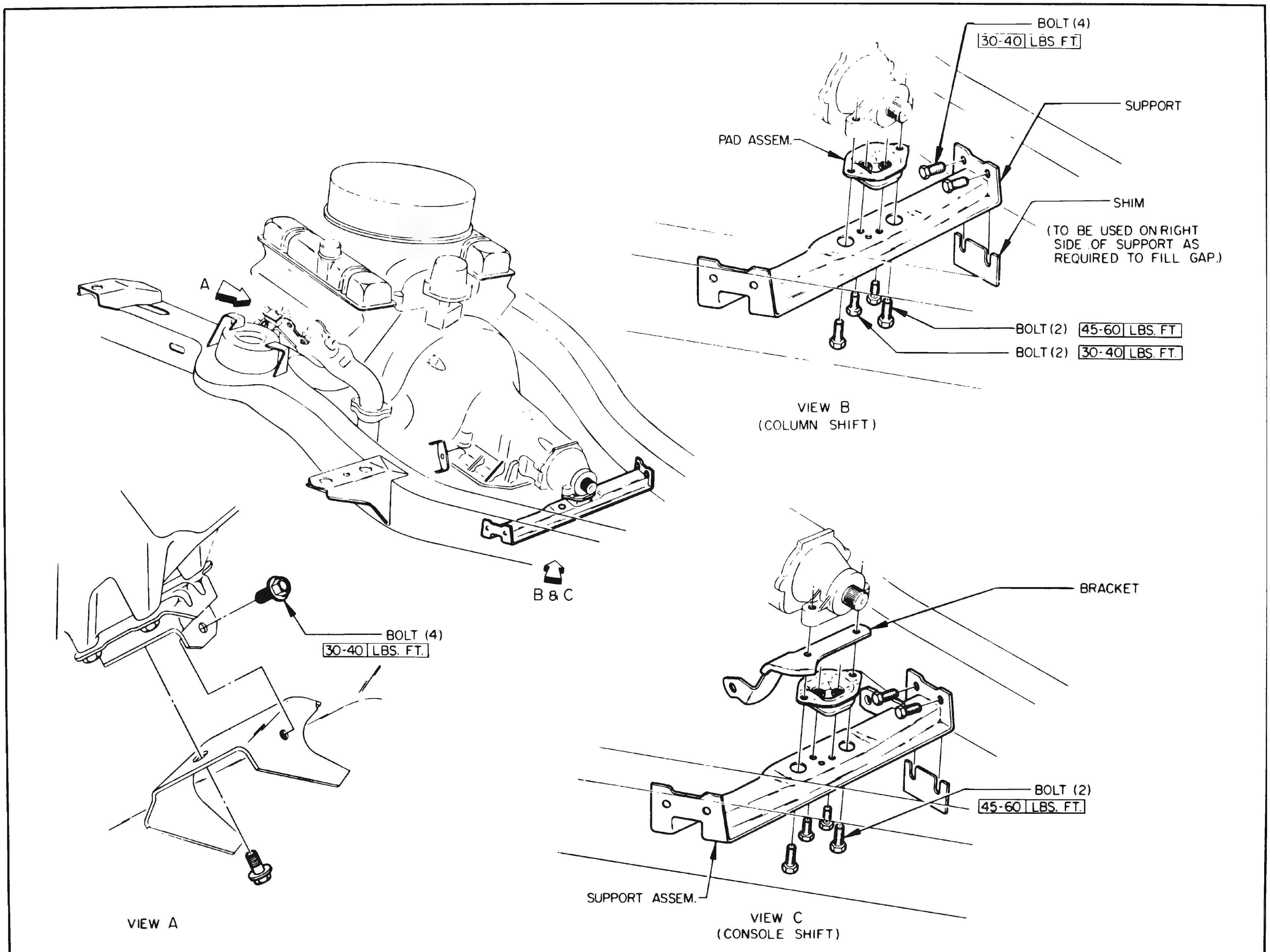


Figure 2-4—Engine and Transmission Mounts (4600-4800 Series)

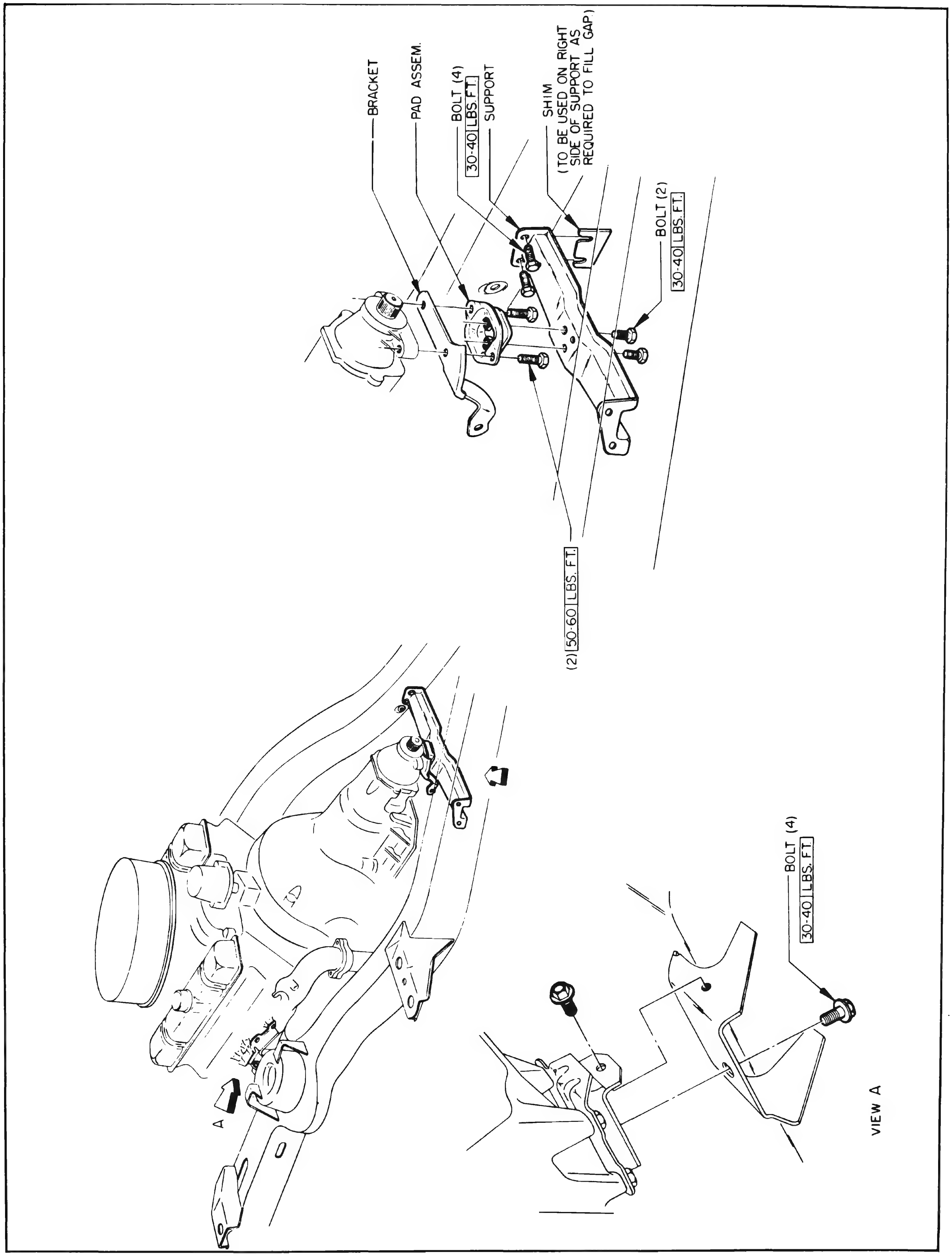


Figure 2-6—Engine and Transmission Mounts (4700 Series)

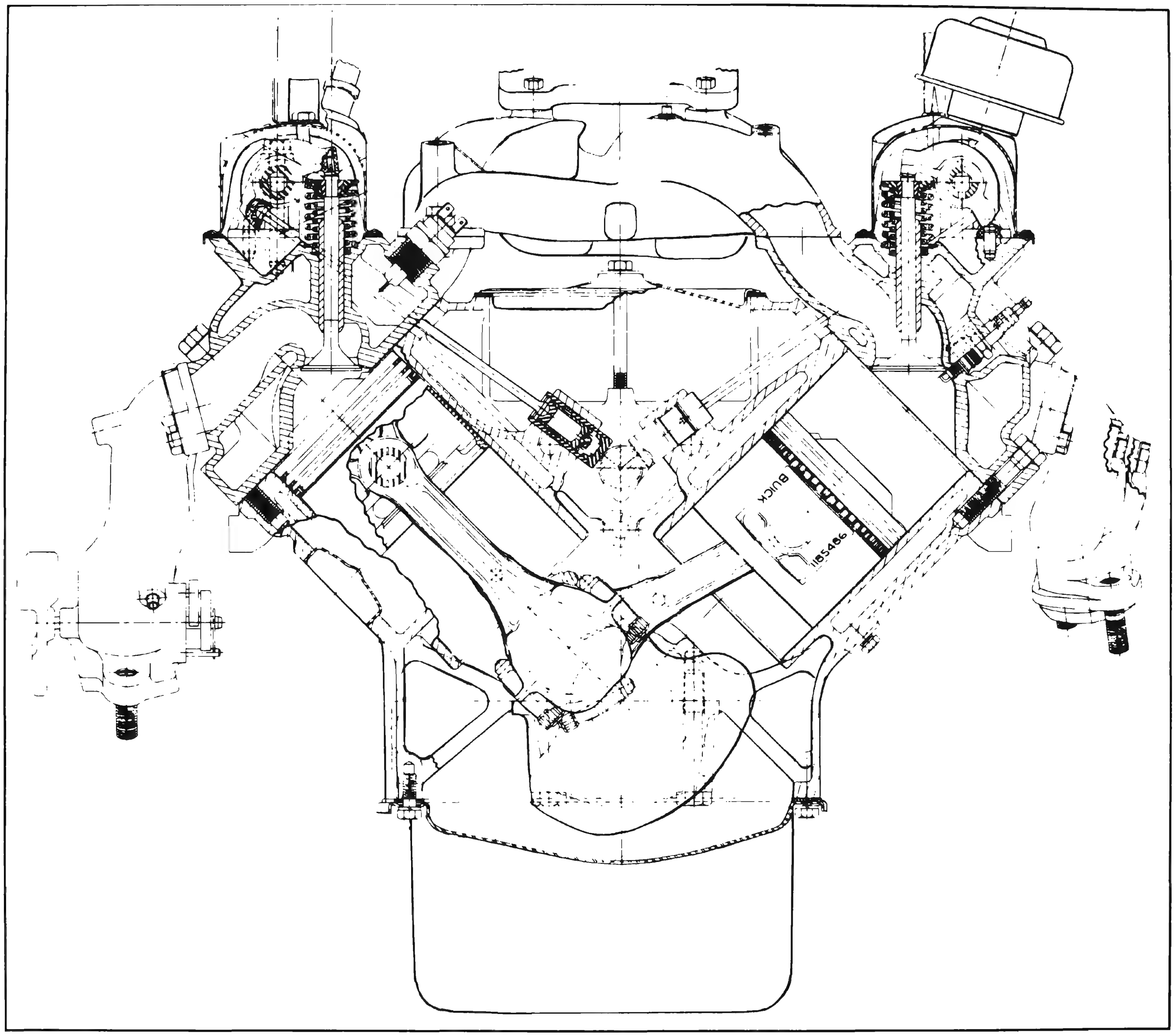


Figure 2-5—401 Cubic Inch Engine End Sectional View

The crankshaft is counterbalanced by weights forged integral with crank cheeks. Maximum counterweighting in the space available is obtained by machining the weights to a contour which allows a minimum uniform clearance with cylinder barrels and piston skirts. Additional counterbalancing is obtained by an offset flywheel flange.

All engines are equipped with a harmonic balancer and fan pulley assembly.

c. Connecting Rods and Pistons

Connecting rods are steel forgings of I-beam section, having bosses on each side so that metal can be removed as required to secure correct weight and balance during manufacture. The lower end of each rod is fitted with a steel-backed full precision type bearing. The upper end of the connecting rod has a hole into which the wrist pin is pressed. The outer ends of the pin float in the bosses in the piston.

The tin plated aluminum alloy pistons have full skirts and are cam ground. Two compression rings and one oil control ring are located above the piston pin. Two transverse slots in the oil ring groove extend through the piston wall and permit drain back of oil collected by the oil ring. Shallow depressions cast into the head provide clearance between the piston and valves in operation. See Figure 2-8.

The cast iron compression rings

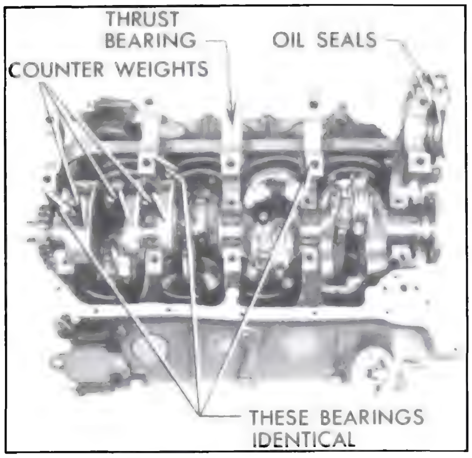


Figure 2-7—Engine Crankshaft and Bearings

in the two upper grooves of piston are distinguished by a bevel cut around the inner edge on one side. The rings are installed with identification mark up. See Figure 2-45.

The oil ring in the lower groove consists of two thin steel rails separated by a spacer (Figure 2-45) and backed by an expander placed in the piston groove. The rails and spacer of a new ring are lightly held together with a cement which dissolves and releases the parts when oil is applied at start of operation.

d. Cylinder Heads

Both cylinder heads are identical except for treatment of the water inlet ports which exist in both ends of each head. When a head is prepared for installation on one bank of cylinders, the water inlet port on the rear end is plugged and the front port is left open for connection to the water pump.

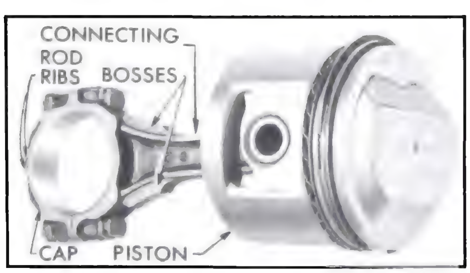


Figure 2-8—Connecting Rod and Piston Assembly

This places the plugs in opposite ends of the right and left heads; therefore, the heads cannot be interchanged.

All valves are mounted vertically in the cylinder head and in line from front to rear, so they operate at 45 degrees to the centerline of cylinders. The angle and location of the inlet valve and port causes the incoming fuel-air charge to sweep angularly downward to one side of the cylinder centerline, resulting in a whirling action which thoroughly mixes the charge and produces a beneficial turbulence during the compression stroke.

With the spark plug located centrally in top of the combustion chamber the point gap is well exposed to the sweep of the incoming charge. This reduces the concentration of exhaust gases that may have remained in this area after exhaust of the previous charge. As noncombustible exhaust products are removed from the area around the spark plug the tendency toward misfiring at part throttle is reduced.

The central location of the spark plug causes burning of the fuel charge to proceed uniformly outward in all directions toward edges of the combustion space. The short flame travel speeds up the combustion process, causing the fuel mixture to burn in a shorter period of time than that at which detonation is likely to occur. High turbulence on the compression stroke and short flame travel following ignition permits the use of a high compression ratio with present day fuels.

e. Camshaft and Valve Mechanism

The camshaft is located in the angle of the cylinder block above the crankshaft where it is supported in five steel-backed, babbitt-lined bearings. It is driven from the crankshaft by sprockets and a single outside guide type chain. See Figure 2-9.

Hydraulic valve lifters and solid one-piece steel push rods are used to operate the overhead rocker arms and valves of both banks of cylinders from the single camshaft. This system requires no lash adjustment at time of assembly or in service; therefore, no adjusting studs or screws are provided in the valve train. Construction and operation of the hydraulic valve lifters are described in subparagraph f below.

The eight rocker arms for each bank of cylinders are mounted on a tubular steel shaft supported on the cylinder head by four die cast brackets. The rocker arms are die cast aluminum with inserts at the push rod socket and the valve stem contact face. See Figure 2-10. The rocker arms are offset to accommodate the different planes of movement of the valves and the push rods which pass through the cylinder head to one side of the valves.

The valves operate vertically in guides pressed into the cylinder head and each valve has two concentric springs to insure positive seating throughout the operating

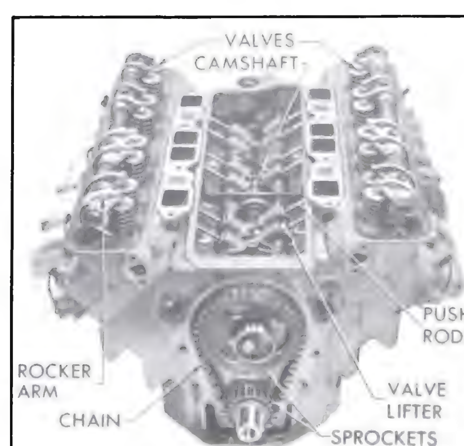


Figure 2-9—Valve Mechanism

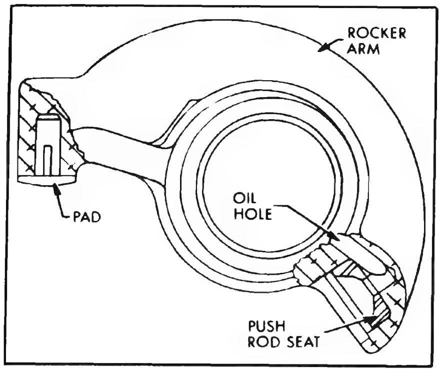


Figure 2-10—Valve Rocker Arm

speed range. Inlet valve heads are 1-7/8" and exhaust valve heads are 1-1/2" in diameter. Valves and rocker arms are protected by a cover which seats against a raised horizontal surface on each cylinder head, and a cork gasket insures against oil leaks.

f. Hydraulic Valve Lifters

In addition to its normal function of a cam follower, each hydraulic valve lifter also serves as an automatic adjuster which maintains zero lash in the valve operating linkage under all operating conditions. By eliminating all lash in the operating linkage and also providing a cushion of oil to absorb operating shocks, the hydraulic valve lifter promotes quiet valve operation. It also eliminates the need for periodic valve adjustment to compensate for wear of parts.

As shown in Figure 2-11, all parts of a hydraulic lifter are housed in the body, which is the cam follower. The body and the plunger are ground to very close limits, then a plunger is selectively fitted to each body to assure free movement with very little clearance. The push rod seat is free to move with the plunger in the body and, as its name implies, it provides a spherical seat to support the lower end of the push rod.

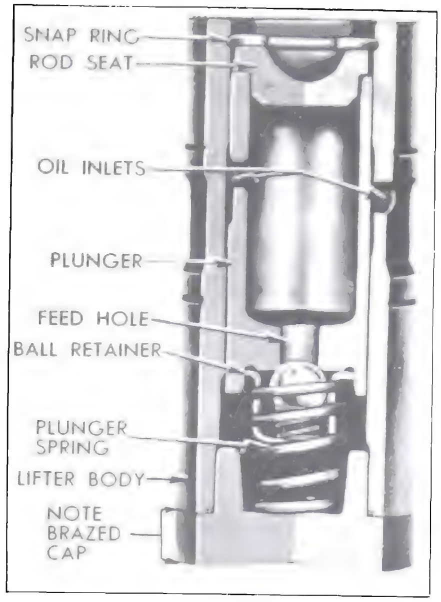


Figure 2-11—Hydraulic Valve Lifter, Sectional View

The plunger and seat are pressed toward the upper end of the lifter body by a coil spring which also holds a check ball retainer against the lower end of the plunger. When lifter is out of engine a spring wire retainer holds all parts in the body. The ball retainer holds a spring loaded check ball in position over the lower end of a feed hole in the plunger. See Figure 2-11.

When the valve lifter is installed in engine the push rod holds the seat and plunger downward clear of the plunger retainer at all times. The plunger spring then presses the lifter body down against the camshaft and presses the plunger and seat up against the push rod with an eight pound load, which is enough to take up all lash clearances between parts in the valve linkage without affecting positive seating of the valve.

Oil is fed to all lifters through galleries in the crankcase, as described in paragraph 2-6. Oil enters each lifter through grooves and oil holes in the lifter body and plunger, and flows down into the chamber below the plunger through the feed hole and around the check ball. The first few cycles of operation after the engine is started forces out all air and completely fills the plunger and lower chamber of each lifter with oil.

At the start of a cycle of valve operation, the lifter body rests on the camshaft base circle. The plunger spring holds all lash clearances out of the valve linkage.

As the rotating camshaft starts raising valve lifter body, oil in the lower chamber and the check ball spring firmly seats the check ball against the plunger to prevent appreciable loss of oil from the chamber. The lifting force against the body is then transmitted through the entrapped oil to the check ball and plunger and push rod seat move upward with the body to operate the linkage which opens the engine valve.

As the camshaft rotates further to close the engine valve, the valve spring forces the linkage and lifter to follow the cam down. When the engine valve seats, the linkage parts and lifter plunger stop but the plunger spring forces the body to follow the cam downward .002" to .003" until it again rests on the camshaft base circle. Oil pressure against the check ball from the lower chamber ceases when the plunger stops and allows passage of oil past the check ball into the lower chamber to replace the slight amount of oil lost by "leak-down".

During the valve opening and closing operation a very slight amount of oil escapes through the clearance between plunger and body and returns to the crankcase. This slight loss of oil (called "leak-down") is beneficial in providing a gradual change of oil in the lifter, since fresh oil enters the lower chamber when

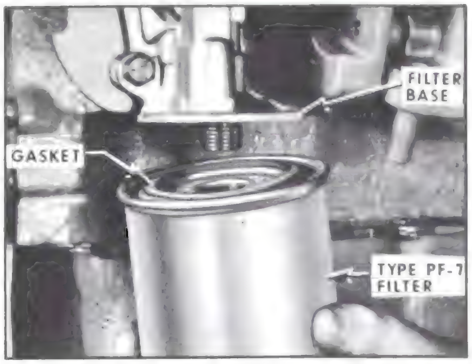


Figure 2-12—Oil Filter Installation

pressure is relieved on the check ball at the end of each cycle of operation.

It should be noted that during each cycle of operation the vertical movement between the body and plunger is only .002" to .003" but the check ball moves through its full travel of .004" to .008". Full opening of the plunger feed hole at the end of each cycle not only permits replacement of oil lost from the lower chamber, as previously described, but also permits control of the volume of oil in lower chamber to compensate for expansion and contraction of the valve linkage parts due to changes in engine temperature.

When engine temperature increases and the valve linkage parts expand, the plunger must move to a slightly lower position in the lifter body to assure full closing of the engine valve. When engine temperature decreases and the linkage parts contract, the plunger must move to a slightly higher position in body to prevent lash clearances in the valve linkage. In either case, the capacity of the lower chamber changes and the volume of oil present is automatically controlled by passage of oil through the open plunger feed hole.

2-6 ENGINE LUBRICATION SYSTEM

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to crankshaft, connecting rods, and camshaft bearings, and is supplied under controlled volume to the valve lifters, rocker arm bearings, and push rods. All other moving parts are lubricated by gravity flow or splash. See Figure 2-14.

a. Oil Supply
401 & 425 Engine

The supply of oil is carried in the lower crankcase (oil pan) which is filled through filler caps in the rocker arm covers. The filler openings are covered by combination filler and ventilating caps which contain filtering material to exclude dust. A removable oil gauge rod on right side of crankcase is provided for checking oil level.

b. Oil Pump
401 & 425 Cu. In. Engine

Oil is picked up and circulated by the spur-geared oil pump assembly which is mounted on the lower side of the cylinder crankcase at the rear end, where it extends down into the oil sump. The pump shaft is coupled to the ignition distributor shaft, which is driven from the camshaft through spiral gears. The pump inlet is equipped with a stationary screen of ample area. If the screen should become clogged for any reason, oil may be drawn into the pump over the top edge of the screen, which is held slightly clear of the screen housing by three embossments. The oil pump body contains a non-adjustable spring loaded pressure valve, which regulates the maximum oil pressure to 40 pounds.

Drilled passages in the oil pump body and cylinder crankcase conduct all oil from the pump to the oil filter.

The oil pump is located in the timing chain cover where it is connected by a drilled passage in the cylinder crankcase to an oil screen housing and pipe assembly. The screen is submerged in the oil supply and has ample area for all operating conditions. If the screen should become clogged for any reason, oil may be drawn into the system over the top edge of the screen which is held clear of the sheet metal screen housing.

Oil is drawn into the pump through the screen and pipe assembly and a drilled passage in the crankcase which connects to drilled passages in the timing chain cover. All oil is discharged from the pump to the oil pump cover assembly. The cover assembly consists of an oil pressure relief valve, an oil filter by-pass valve and a nipple for installation of an oil filter. The spring loaded oil pressure relief valve limits the oil pressure to a maximum of 33 pounds per square inch. The oil filter by-pass valve opens when the filter has become clogged to the extent that 4-1/2 to 5 pounds pressure difference exists between the filter inlet and exhaust to by-pass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine. See Figure 2-13.

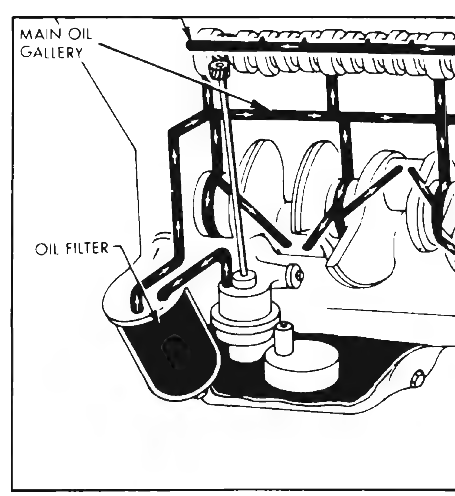


Figure 2-13—Oil Flow (401 and 425 Cu. In. Engine)

Oil Filter. The AC full flow type oil filter is externally mounted on the right side of crankcase. The filter permits rapid passage of oil with a minimum drop in pressure. Normally, ALL engine oil passes through the filter element. If the element becomes restricted enough to produce 4-1/2 to 5-1/2 pounds difference in pressure between the inlet and outlet ports of the filter, a spring-loaded ball type valve in the filter base will open to by-pass the element and route oil directly into the main oil gallery.

Main Oil Gallery. The main oil gallery runs full length of the crankcase in the angle below the camshaft. Through connecting passages drilled in the crankcase it distributes oil at full pressure to all crankshaft and camshaft bearings, from which oil is then distributed to all other working parts of the engine. See Figure 2-14. See 2-15 for 300 cu. in. engine.

Crankshaft, Rods, and Pistons. Holes drilled in the crankshaft carry oil from the crankshaft bearings to the connecting rod bearings. Pistons and cylinder walls are lubricated by oil forced through a small notch in the bearing parting surface on connecting rod, which registers with the hole in the crankpin once in every revolution. Piston pins are lubricated by splash.

Timing Chain and Sprockets. A small amount of oil which escapes from the camshaft front bearing flows down the front face of the cylinder crankcase to drop on the crankshaft sprocket, from which

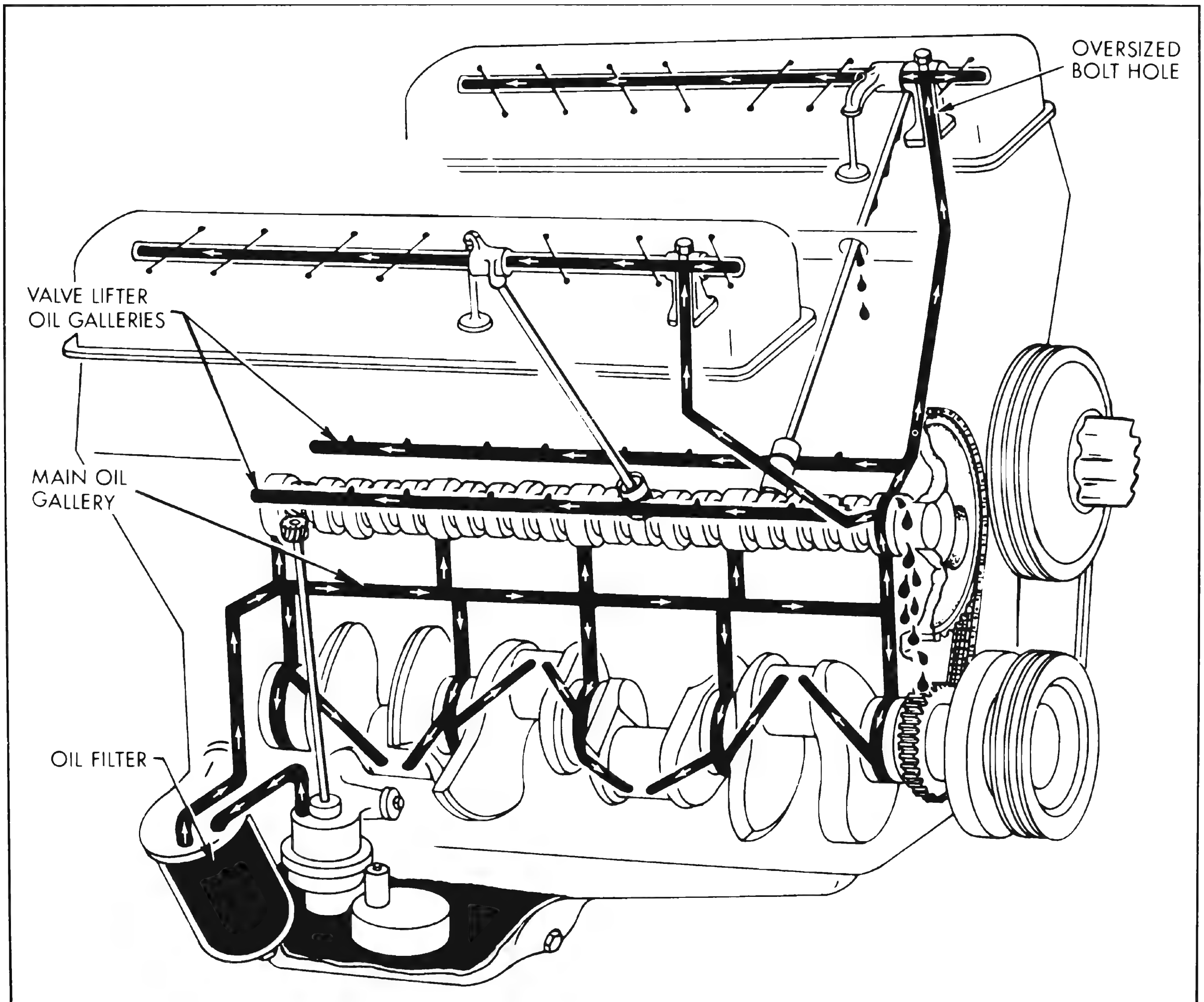


Figure 2-14—Schematic Diagram of Engine Oil Flow (401 & 425 Cu. In. Engines)

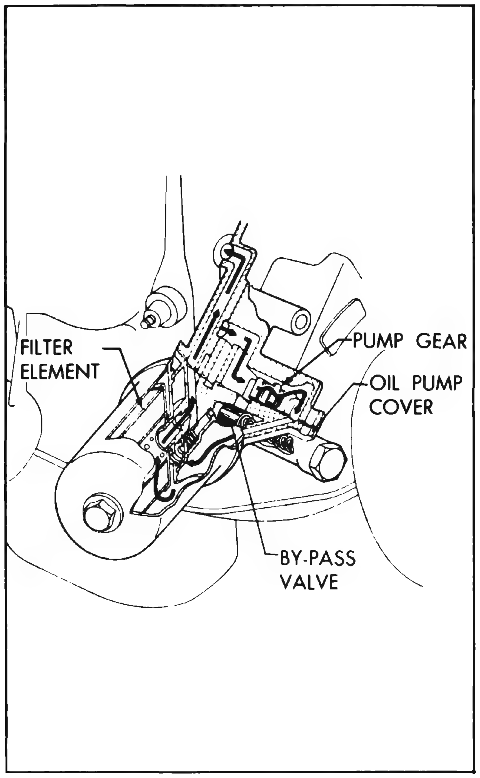


Figure 2-15—Oil Flow (300 Cu. In. Engine)

it is then transferred to the timing chain.

Valve Lifters and Oil Galleries. Oil holes in the crankcase and camshaft front bearing align with a groove in the camshaft front bearing journal which meters the flow of oil from the main oil gallery to the valve lifter oil gallery in each bank of cylinders. The drilled oil gallery, running full length of each cylinder bank, cuts into the lower sides of all valve lifter guide holes to supply an adequate volume of low pressure oil to each hydraulic valve lifter. Oil enters each lifter through grooves and holes in the lifter body and the plunger. See Figure 2-14.

Rocker Arms, Valves, and Push Rods. The rocker arms and valves on each cylinder head are supplied with low pressure oil from the valve lifter oil gallery through connecting passages drilled in the front end of cylinder block and head. See Figure 2-14.

The oil passage in cylinder head ends in a counterbored recess surrounding the bolt which attaches the rocker arm shaft front bracket. The oversize bolt hole through the bracket permits oil to flow up into the hollow rocker arm shaft, which is plugged at both ends.

Each rocker arm receives oil through a hole in the shaft, and parallel grooves in the rocker arm assure proper lubrication of the bearing surface. Oil is metered to the push rod ball seat and to the valve stem through holes drilled in the rocker arm. Excess oil drains off and returns to the oil pan through passages in cylinder head and cylinder block.

2-7 ENGINE COOLING SYSTEM

The engine cooling system is the pressure type, with thermostatic coolant temperature control and water pump circulation.

A double contact temperature sensitive switch is located in the right cylinder head. On 401 and 425 cu. in. engines, the switch closes one set of contacts to light a green signal on the instrument panel when engine water temperature is below 110°F. If engine water temperature is between 110° and 245° (approximately) neither contact is closed. Engine water temperature above 245° causes the second set of contacts to close and light a red signal on the instrument panel.

A Harrison tube and center type of radiator core of brass and copper is used on all models. The lower radiator tank houses the transmission oil cooler.

All engines are equipped with an 18" fan. Air conditioned cars are equipped with a 20" fan driven by a torque and temperature sensitive clutch. See Figure 2-16.

Figure 2-16—Fan Clutch

The torque sensitive fan clutch is equipped with a temperature sensitive coil which controls the flow of silicone through the clutch.

During periods of operation when radiator discharge air temperature is low, the fan clutch limits the fan speed to 800 to 1200 RPM. Operating conditions that produce high radiator discharge air temperatures cause the temperature sensitive coil to turn a shaft which opens a port inside the clutch. This open port allows a greater flow of silicone providing a maximum fan speed of approximately 2100 RPM.

The clutch coil is calibrated so that at road load with an ambient temperature of 80°F the clutch is just at the point of shift between high and low fan speed.

The cooling system is sealed by a pressure type radiator filler cap which causes the system to operate at higher than atmospheric pressure. The higher pressure raises the boiling point of coolant and increases the cooling efficiency of the radiator. The fifteen pound pressure cap used on all series permits a possible increase of approximately 38°F. in boiling point of coolant.

The pressure type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve. See Figure 2-17. The pressure valve is held

against its seat by a spring of pre-determined strength which protects the radiator by relieving the pressure if an extreme case of internal pressure should exceed that for which the cooling system is designed. The vacuum valve is held against its seat by a light spring which permits opening of the valve to relieve vacuum created in the system when it cools off and which otherwise might cause the radiator to collapse.

The coolant is circulated by a centrifugal pump mounted on the timing chain cover which forms the outlet side of the pump. The fan and pulley(s) are bolted to the forward end of the pump shaft. In this manner both the fan and pump are belt driven by a crankshaft driven pulley mounted forward of the harmonic balancer.

The pump shaft is supported on two single row ball bearings pressed on the shaft and shrunk fit in the aluminum water pump cover. The bearings are permanently lubricated during manufacture and sealed to prevent loss of lubricant and entry of dirt.

The pump is sealed against coolant leakage by a packless nonadjustable seal assembly mounted in the pump cover in position to bear against the impeller hub. See Figure 2-18.

The inlet pipe cast on the pump cover feeds into the passage formed by the cover and the front

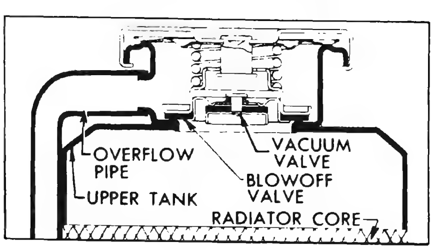


Figure 2-17—Pressure Type Radiator Cap Installation

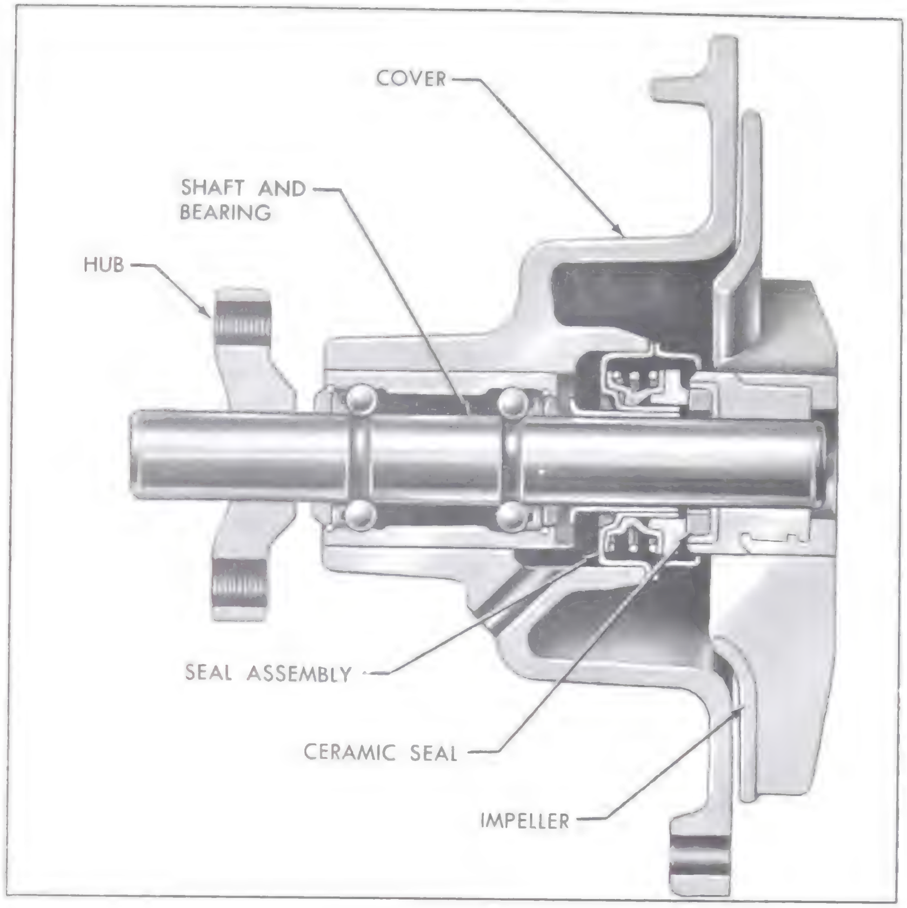


Figure 2-18—Water Pump Cover Assembly

face of the impeller, which is mounted on the bearing shaft with the vanes facing rearward. Coolant flows through the inlet passage to the low pressure area at the center, where it then flows rearward through three holes in the impeller. Vanes on the rotating impeller cause the coolant to flow radially outward into two discharge passages cast in the timing chain cover, and these passages deliver an equal quantity of coolant to each cylinder bank water jacket.

Cylinder water jackets extend down below the lower limits of piston ring travel and the coolant completely surrounds each cylinder barrel to provide uniform cooling. To this point, coolant circulation in the 300 cu. in. V-8 and the 401 and 425 V-8 are identical. In the 300 cu. in. V-8 the coolant flows into the intake manifold water jacket from the forward port in the cylinder heads. The coolant flows to the rear in the lower portion of the intake manifold and then forward in the upper portion to the thermostat housing and thermostat by-pass. The flow of heated coolant through the intake manifold water jacket warms the manifold evenly to provide good vaporization of the incoming fuel charge. A port in the rear of the manifold allows connection to the heater hose in heater equipped cars. See Figure 2-19.

In the 401 and 425 cu. in. engine the coolant leaves the cylinder heads through a water manifold that provides a common connection between both heads and the radiator. The water manifold also houses the "pellet" type radiator

thermostat and provides the by-pass passage through which coolant returns to the water pump for recirculation whenever the thermostat valve closes to block circulation through the radiator. This thermostatically operated by-pass type of water temperature control permits the engine to reach its normal operating temperature quickly. The thermostat valve opens at 180 degrees F.

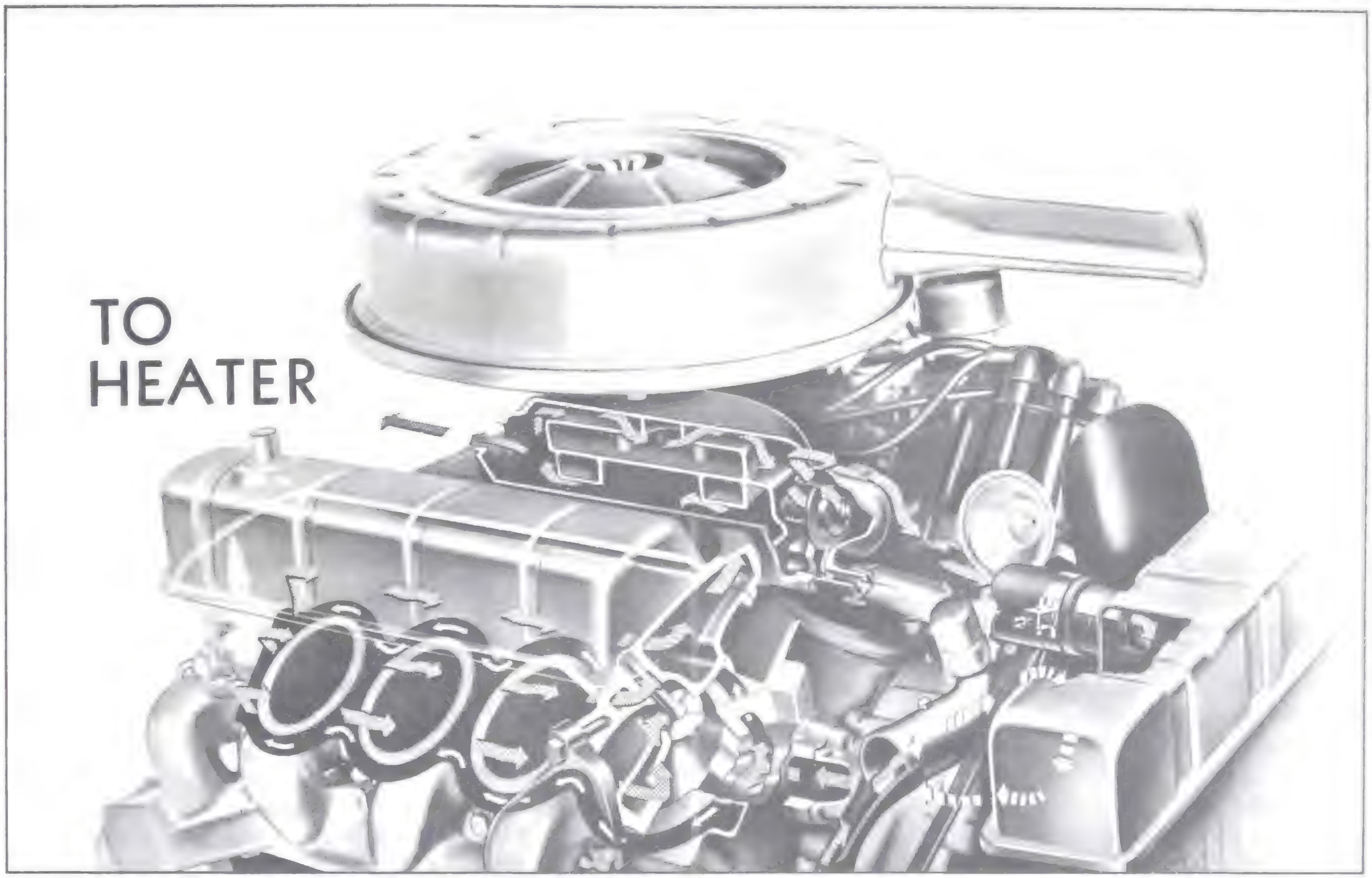


Figure 2-19—Coolant Flow (300 Cu. In. Engine)

SECTION 2-C
ENGINE TUNE-CARE AND TROUBLE DIAGNOSIS

CONTENTS OF SECTION 2-C

2-8 ENGINE TUNE-CARE

a. Tune-Care Procedure

The purpose of an engine tune-care is to restore power and performance that has been lost through wear, corrosion, or deterioration of one or more parts or units. In the normal operation of an engine these changes take place gradually at quite a number of points so that it is seldom advisable to attempt an improvement in performance by correction of one or two items only. Time will be saved and more lasting results will be assured by following a definite and thorough procedure of analysis and correction of all items affecting power and performance.

Economical, trouble-free operation can better be assured if a complete Tune-care is performed each 12,000 miles.

The parts or units which affect power and performance may be divided, for analysis, into three groups in accordance with their function in producing (1) Compression (2) Ignition (3) Carburetion. The tune-care procedure should cover these groups in the order given. While the items affecting compression and ignition may be handled according to individual preference, correction of items in the carburetion group should not be attempted until all items in compression and ignition has been satisfactorily corrected.

Most of the procedures required for complete engine tune-care are covered separately in other sections of this manual; therefore, this paragraph gives an outline only, with references to the numbered paragraphs where detailed information is given. The suggested procedure for engine tune-care is as follows:

1. Remove all spark plugs and test compression pressure in all cylinders, using a reliable pressure gauge as follows:

(a) Connect jumper wire between distributor terminal of coil and ground on engine to avoid high tension sparking while cranking engine. Turn ignition switch "ON."

(b) Insert rubber fitting of compression gauge into a spark plug port and hold gauge tightly in position.

(c) Push throttle wide open and crank engine until compression gauge reaches its highest reading, which should require only a few revolutions of engine.

(d) Repeat this test on all cylinders, making sure to fully release pressure in gauge after each test. Make record of readings.

(e) The compression gauge hand should jump to about 75 pounds on the first compression stroke, with a few more strokes giving maximum pressure. If the pressure is built up in the gauge in jerky steps of 10 to 20 pounds at a time, it indicates leakage of pressure at some point such as head gasket, valves, or piston rings.

(f) Minimum acceptable compression pressures at cranking speed (160 RPM) are approximately as follows:

10.25 to 1 Compression Ratio Engines . . . . . . 180 lbs./sq. in.
9.0 to 1 Compression Ratio Engines . . . . . . 160 lbs./sq. in.

Engines newly broken in may have compression pressure considerably higher than shown above. Pressure variation between all cylinders should not exceed approximately 15 lbs./ sq. in.

(g) Low compression pressure in two adjacent cylinders indicates a head gasket leak between the two cylinders.

2. Clean, inspect, gap and install spark plugs (par. 10-42).

3. Inspect battery and cables; fill battery to proper level (par. 10-15).

4. Test cranking motor circuit if battery is in good condition but cranking speed is low (par. 10-34).

5. Adjust fan belt (par. 2-21) and inspect generator (par. 10-23).

If difficulty is experienced in keeping battery charged, test generator regulator (par. 10-26).

6. Inspect entire ignition system and make indicated corrections. (subpar. b, below)

7. Inspect and test fuel pump (par. 3-12).

8. Replace gasoline filter, free up and lubricate manifold heat valve (par. 3-7).

9. Check operation of choke valve and setting of choke thermostat (par. 3-8).

10. Check adjustment of fast idle cam and choke unloader (Carter par. 3-17; Rochester par. 3-29).

11. Check throttle linkage adjustment, also dash pot adjustment. (par. 3-9).

12. Adjust carburetor and set idle speed (par. 3-8).

13. Inspect all water hose connections and tighten clamps.

14. Road test car for power and overall performance.

b. Tune-Care Specifications

Check Points	Allen Uni-Tuner	Sun Tune-Up Tester
1. Secondary Resistance	27 Min. @ 1500 RPM	3 ± .5 Volts @ 1500 RPM
2. Ignition Output	26 Min. @ 1500 RPM	Blue Band @ 1500 RPM
3. Cranking Voltage	9 Volts Min.	
4. Charging Voltage * (Quick Check)	14-15 Volts @ 1500 RPM	
5. Spark Plug Gap	.035 Inches	
6. Dwell Angle	30 Degrees	
7. Engine Vacuum	14 Inches Min. @ Idle	
8. Engine Idle Speed	300 Cu. In. 550 RPM, All Others 500 RPM (Add 50 RPM if Air Cond.)	

	425 Cu. In. Engine Dual Four Barrel Auto Trans.	425 Cu. In. Engine	300 Cu. In. Engine
9. Initial Timing *	12 BTC	2 1/2°	2 1/2°
10. Total Distributor Advance (@ 2500 Engine RPM)	25° -33°	34° -41°	32° -39°
11. Centrifugal Advance Only (@ 2500 Engine RPM)	10° -14°	20° -24°	17° -21°

* Adjust engine idle as specified, then disconnect vacuum hose.

2-9 HARD STARTING IMPROPER PERFORMANCE, EXCESSIVE FUEL OR OIL CONSUMPTION

a. Hard Starting, Improper Performance, Excessive Fuel Consumption

These subjects are covered in Section 3-B. See paragraph 3-4 for hard starting, paragraph 3-5 for improper engine performance, and paragraph 3-6 for excessive fuel consumption.

b. Excessive Oil Consumption

If an engine is reported to be using an excessive amount of oil, a thorough inspection should be made for external leaks and the conditions of operation should be carefully considered before assuming that the engine is using too much oil as a result of an internal condition.

Place clean paper on the floor under engine and run the engine at medium speed until the oil is thoroughly warmed up, then stop the engine and check for oil leaks and dripping on the paper. Inspect both sides and front and rear ends of engine for wet spots. Pay particular attention to rocker arm cover, timing chain cover, and lower crankcase gaskets. All external leaks should be corrected and the results noted before attempting any internal correction.

The conditions of operation have an important bearing on oil consumption. The following points should be checked:

(1) Improper reading of oil gauge rod. An erroneous reading will

be obtained if car is not level, gauge rod is not pushed down against stop, or insufficient drain-back time (1 minute) is not allowed after stopping engine. An over-supply of oil may be added if gauge rod markings are not understood. The space between the "FULL" and "ADD" marks represents 1 quart.

(2) Oil too light. The use of oil of lower viscosity than specified for prevailing temperatures will contribute to excessive oil consumption.

(3) Continuous high speed driving. In any automobile engine, increased oil consumption per mile may be expected at speeds above 60 MPH.

(4) High speed driving following slow speed town driving. When a car is used principally for slow speed town driving under conditions where considerable crankcase dilution occurs, a rapid lowering of oil level may occur when the car is driven for some distance at high speed. This is because the dilution from town driving is removed by the heat of the high speed driving. This is a normal condition and should not be mistaken for excessive consumption.

(5) Valve guides worn. Excessively worn valve guides may cause excessive oil consumption.

(6) Piston rings not worn in. A new engine, or an engine in which new rings have been installed, will require sufficient running to wear in the rings to provide proper seating against the cylinder walls. During the wear-in period a higher than average oil consumption is to be expected, and no attempt should be made to improve oil economy by replacing rings before the engine has been in service for at least 3000 miles.

2-10 EXCESSIVE VALVE NOISE

a. Checking Noise Level of Valve Mechanism

The noise level of the valve mechanism cannot be properly judged when the engine is below operating temperature, when hood is raised, or when rocker arm covers are removed. At approximately 500 RPM to 1200 RPM, particularly when engine is cold, the valve mechanism has a normal operating noise which is audible with the hood raised, and still more audible when rocker arm covers are removed.

When engine is at operating temperature close the hood and listen for valve noise while sitting in the driver's seat. Run engine at idle speed, then at various higher speeds. The noise level of the valve mechanism should be very low as observed from the driver's seat. It is advisable to observe the valve noise level in a number of engines that have been properly broken in, in order to develop good judgment for checking the noise level in any given engine.

b. Causes of Noise in Valve Mechanism

If the preceding check indicates that the valve mechanism is abnormally noisy, remove the rocker arm covers so that the various conditions which cause noise may be checked.

A piece of heater hose of convenient length may be used to pick out the particular valves or valve linkages that are causing abnormal noise. With the engine running at a speed where the noise is pronounced, hold one end of hose to an ear and hold other end about 1/2" from the point of contact between each rocker arm and valve stem. Mark or record location of the noisy valves for investigation of the following causes.

(1) Excessive Oil in Crankcase. A crankcase oil level high enough to permit the crankshaft to churn the oil will cause air bubbles in the lubricating system. Air bubbles entering the hydraulic valve lifters will cause erratic operation resulting in excessive lash clearance in valve linkage. Find and correct cause of high oil level, adjust oil to proper level (par. 1-1), then run engine long enough to expel all air from lubrication system and lifters.

(2) Sticking, Warped, or Eccentric Valves, Worn Guides. Sticking valves will cause irregular engine operation or missing on a low-speed pull, and will usually cause intermittent noise. Pour penetrating oil over the valve spring cap and allow it to drain down the valve stem. Apply pressure to one side of valve spring and then to opposite side, and then rotate valve spring about 1/2 turn. If these operations affect the valve noise it may be assumed that valves should be reconditioned (par. 2-14).

(3) Worn or Scored Parts in Valve Train. Inspect rocker arms, ball studs, push rod ends, push rods for bends, valve lifters, and camshaft for worn or scored wearing surfaces. Replace faulty parts.

(4) Valves and Seats Cut Down Excessively. Noisy and improper valve lifter operation may result if a valve and its seat have been refinished enough to raise the end of the valve stem approximately .050" above normal position. In this case it will be necessary to grind off end of valve stem or replace parts.

The normal height of the valve stem above the valve rocker arm gasket surface of the cylinder head is 1.540".

(5) Faulty Hydraulic Valve Lifters. If the preceding suggestions do not reveal the cause of noisy valve action, check operation of the hydraulic valve lifters as described in subparagraph c.

c. Checking Hydraulic Valve Lifters

When checking hydraulic valve lifters, remember that grit, sludge, varnish or other foreign matter will seriously affect operation of these lifters. If any of these foreign substances are found in the lifters or anywhere in the engine where they may be circulated by the lubrication system, a thorough cleaning job must be done to avoid a repetition of valve lifter trouble.

To guard against entrance of grit into the lifters the engine oil must be changed as recommended in paragraph 1-6 and the oil filter element must be changed as recommended in paragraph 1-2. The engine oil must be the heavy duty type (par. 1-6) to avoid detrimental formation of sludge and varnish. The car owner should be specifically advised of these requirements when the car is delivered.

Faulty valve lifter operation usually appears under one of the following conditions.

(1) Rapping Noise Only When Engine is Started. When engine is stopped any lifter that is on a camshaft lobe is under pressure of the valve springs; therefore leak-down or escape of oil from lifter lower chamber occurs. When the engine is started a few seconds may be required to fill the lifter, particularly in cold weather when oil is sluggish. If noise occurs from this cause only occasionally it may be considered normal and requiring no correction. If noise occurs almost daily, however, check for: (a) Oil too heavy for prevailing temperatures (par. 1-6; (b) Excessive varnish in lifter.

(2) Intermittent Rapping Noise. An intermittent rapping noise that Appears and disappears every few seconds indicates leakage at check ball seat due to foreign particles, varnish, or defective surface of check ball or seat. Recondition noisy lifters (par. 2-15) checking carefully for presence of grit or metal particles, which would require a thorough cleaning to remove source of such material.

(3) Noise on Idle and Low Speed. If one or more valve lifters are noisy on idle and up to approximately 25 MPH but quiet at higher speeds, it indicates excessive leak-down rate or faulty check ball seat on plunger. With engine idling, lifters with excessively fast leak-down may be spotted by pressing down on each rocker arm above the push rod with equal pressure. Recondition noisy lifters (par. 2-16).

(4) Generally Noisy at All Speeds. Check for high oil level in crankcase. See subparagraph b (1) above. With engine idling, strike each rocker arm above push rod several sharp blows with rawhide hammer; if noise disappears it indicates that foreign material was keeping check ball from seating. Stop engine and place lifters on camshaft base circle. If there is lash clearance in any valve linkage it indicates a stuck lifter plunger, worn lifter body lower end, or worn camshaft lobe. Recondition noisy lifter (par. 2-16).

(5) Loud Noise at Normal Operating Temperature Only. If a lifter develops a loud noise when engine is at normal operating temperature but is quiet when engine is below normal temperature it indicates an excessively fast leak-down rate or score marks on lifter plunger. Recondition lifter (par. 2-16).

2-11 ENGINE VIBRATION OR NOISE

If unusual vibration or noise develops in the operation of a car, test first to determine whether the condition originates in the engine or in other operating units. Time will often be saved by checking the recent history of the car to find out whether the vibration or noise developed gradually or became noticeable following an accident or installation of repair parts.

Vibration or noise is usually most pronounced when driving at a certain speed. If the engine is run at the equivalent or critical speed with car standing and transmission in neutral, the condition will still exist if the engine or transmission is at fault. If the condition does not exist with engine running and car standing still refer to Rear Axle Trouble Diagnosis (Section 6-3) and Chassis Suspension Trouble Diagnosis (Section 7-B).

If vibration or noise exists with engine running and car standing still, the following items should be investigated and corrected as required.

a. Engine Tune-Care

An engine which is not properly tuned will run rough and vibrate,

particularly at idling and low speeds. A thorough engine tune-care operation is the proper correction (par. 2-10).

b. Fan, Delcotron Generator Belt, or Water Pump

Bent fan blades will cause vibration and noise. Fan blades may be bent by accident or by the objectionable practice of turning the engine by means of the blades.

Remove fan belt and run engine. If vibration or noise is eliminated or reduced it indicates that the condition is caused by the fan, generator, belt, or possibly the water pump.

Check water pump for rough or noisy bearing and replace parts if necessary.

Inspect fan belt, all pulleys, balancer, fan blades, and Delcotron generator for undercoating or other material that would cause an unbalanced condition. Examine fan belt for abnormally thick or thin sections.

Check fan blades for excessive runout and correct if necessary. Check all pulleys for abnormal runout or wobble and replace if necessary.

Reinstall fan belt and adjust to proper tension. See Figures 2-46, 2-47, 2-48 and 2-49.

With engine running, place one hand on generator and slowly open throttle from idle to approximately 60 MPH. If generator vibrates enough to create a noise in the engine or car it will vibrate enough to be felt by the hand. As the engine is slowly speeded up the generator might be felt to go into periods of vibration at different engine speeds. Noise caused by the generator should occur at the same time that generator vibration occurs. Repair or replace a noisy generator.

If the generator is causing a moan or whine it will increase in intensity when car lights are turned on. Replacement of generator is generally the only remedy for this condition.

c. Engine Mountings

Vibration may be caused by broken or deteriorated engine mountings, or by mountings, or by mountings that are loose or improperly adjusted. Adjust and tighten loose mountings (par. 2-26) or replace faulty mountings.

d. Crankshaft Balancer

Loose or broken rivets in the crankshaft balancer may cause vibration in the engine. If the balancer is damaged by accident in such manner that the parts cannot function freely, extreme roughness will be produced which may eventually cause breakage of the crankshaft if it is not corrected. A balancer which shows external evidence of damage or which is suspected of being inoperative should be replaced and the result checked, since it is not possible to test the balancer in any other way.

e. Unbalanced Connecting Rods or Pistons

Vibration will result if connecting rods or pistons are installed which are not of equal weight with all other rods or pistons in engine. If new parts have recently been installed, these should be checked to determine whether they are standard Buick parts or have been altered in weight by filing, machining, or other repairs.

f. Unbalanced Flywheel or Converter Pump

Vibration may be due to unbalanced flywheel or the converter pump. Procedure for balancing these parts is given in paragraph 2-28.

2-12 COOLING SYSTEM TROUBLE DIAGNOSIS

a. Excessive Water Loss

If the radiator is filled too full when cold, expansion when hot will overfill the radiator and coolant will be lost through the overflow pipe. Adding unnecessary water will weaken the anti-freeze solution and raise the temperature at which freezing may occur. To avoid losses from this cause never fill radiator beyond half way between core and tank top.

If the cooling system requires frequent addition of water in order to maintain the proper level in the radiator, check all units and connections in the cooling system for evidence of leakage. Inspection should be made with cooling system cold because small leaks which may show dampness or dripping when cold can easily escape detection when the engine is hot, due to the rapid evaporation of the leakage. Tell-tale stains of grayish white or rusty color, or dye stains from anti-freeze, at joints in cooling system are almost always sure signs of small leaks even though there appears to be no dampness.

Air or gas entrained in the cooling system may raise the level in radiator and cause loss of coolant through the overflow pipe. Air may be drawn into the cooling system through leakage at the water pump seal. Gas may be forced into the cooling system through leakage at the cylinder head gasket even though the leakage is not sufficient to allow water to enter the combustion chamber. The following quick

check for air leaks on suction side of pump or gas leakage from engine may be made with a piece of rubber tubing and a glass bottle containing water.

1. With cooling system cold, add water to bring coolant halfway between core and tank top.

2. Block open the radiator cap pressure valve, or use a plain cap, and be sure radiator cap is on tight. Attach a suitable length of rubber hose to lower end of overflow pipe.

3. Run engine in neutral at a safe high speed until the temperature gauge stops rising and remains stationary; in other words, until the engine reaches a constant operating temperature.

4. Without changing engine speed, put the free end of rubber hose into a bottle of water, avoiding kinks or low bends that might block the flow of air.

5. Watch for air bubbles in water bottle. A continuous flow of bubbles indicates that air is being sucked into the cooling system, or exhaust gas is leaking into the cooling system past the cylinder head gasket.

b. Overheating of Cooling System

It must be remembered that the Buick pressure system operates at higher temperatures than systems operating at atmospheric pressure. Depending on the pressure in cooling system, the temperature of water or permanent type anti-freeze may go considerably above 212°F without danger of boiling.

In cases of actual overheating the following conditions should be checked:

1. Excessive water loss (subpar. b, above).

2. Slipping or broken fan belt (par. 2-22).

3. Radiator thermostat stuck (par. 2-23), radiator air passages clogged, restriction in radiator core, hoses, or water jacket passages.

4. Improper ignition timing (par. 10-41).

5. Improper carburetor adjustment (par. 3-8).

6. Exhaust manifold valve stuck (par. 3-7).

7. Shortage of engine oil or improper lubrication due to internal conditions.

8. Dragging brakes.

SECTION 2-D

CYLINDER HEAD AND VALVE MECHANISM SERVICE

CONTENTS OF SECTION 2-D

2-13 CYLINDER HEAD AND VALVE SERVICE

a. Removal of Cylinder Head

1. Drain the radiator and cylinder block.

2. Remove air cleaner and silencer, then disconnect all pipes and hoses from carburetor and intake manifold.

3. Disconnect wires from accelerator vacuum switch, remove coil, remove throttle return spring.

4. Remove intake manifold and carburetor as an assembly. Remove manifold gaskets.

5. When removing RIGHT cylinder head; (1) remove oil gauge rod, (2) disconnect automatic transmission filler pipe bracket from head, (3) remove generator mounting bracket, (4) remove air conditioning compressor, if present.

6. When removing LEFT cylinder head; (1) remove power steering gear pump with mounting bracket if present, and move it out of the way with hoses attached.

7. Disconnect wires from spark plugs.

8. Disconnect water manifold from both cylinder heads and disconnect exhaust manifold from head to be removed.

9. With air hose and cloths, clean dirt off cylinder head and adjacent area to avoid getting dirt into engine. It is extremely important to avoid getting dirt into the hydraulic valve lifters.

10. Remove rocker arm cover and remove rocker arm and shaft assembly from cylinder head. Lift out push rods.

NOTE: Due to the close clearances in the engine compartment it is necessary to leave some of the bolts and push rods in the head during removal. The push rods should be pulled up and taped in position while cylinder head is being removed. These same parts must be in the head during installation.

11. Slightly loosen all cylinder head bolts then remove bolts and lift off the cylinder head. Remove gasket.

12. With cylinder head on bench, remove all spark plugs for cleaning and to avoid damage during work on the head.

b. Reconditioning Valves and Guides

1. Place cylinder head on Holding Fixture J-5251 with valve springs straight up. Compress valve springs with fixture lever and remove the spring cap keys, then remove the springs and caps. See Figure 2-19A.

2. Carefully roll cylinder head away from holding fixture until one edge rests on bench, then remove valves. Place valves in a stick with numbered holes to keep them in order for reinstallation in original positions.

3. Scrape all carbon from combustion chambers, piston heads, and valves. Clean all carbon and gum deposits from valve guide bores. When using scrapers or wire brushes for removing carbon, avoid scratching valve seats and valve faces.

4. Inspect valve faces and seats for pits, burned spots or other evidences of poor seating. If a valve head must be ground until the outer edge is sharp in order to true up the face, discard the valve because the sharp edge will run too hot.

5. Check fit of valve stems in guides. If clearance is excessive replace the guides, as follows:

(a) Remove center crossbar from Holding Fixture J-5251, place cylinder head in fixture so that inlet port side rests against the fixture lower bar, then drive

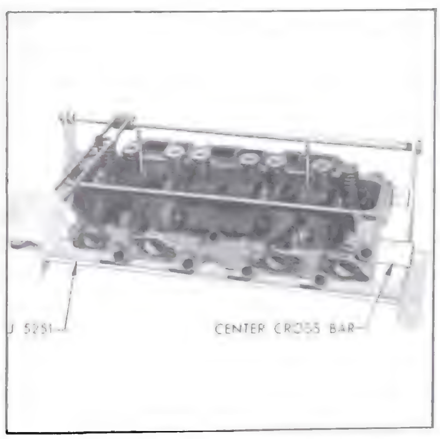


Figure 2-19A—Removing Valve in Holding Fixture J 5251

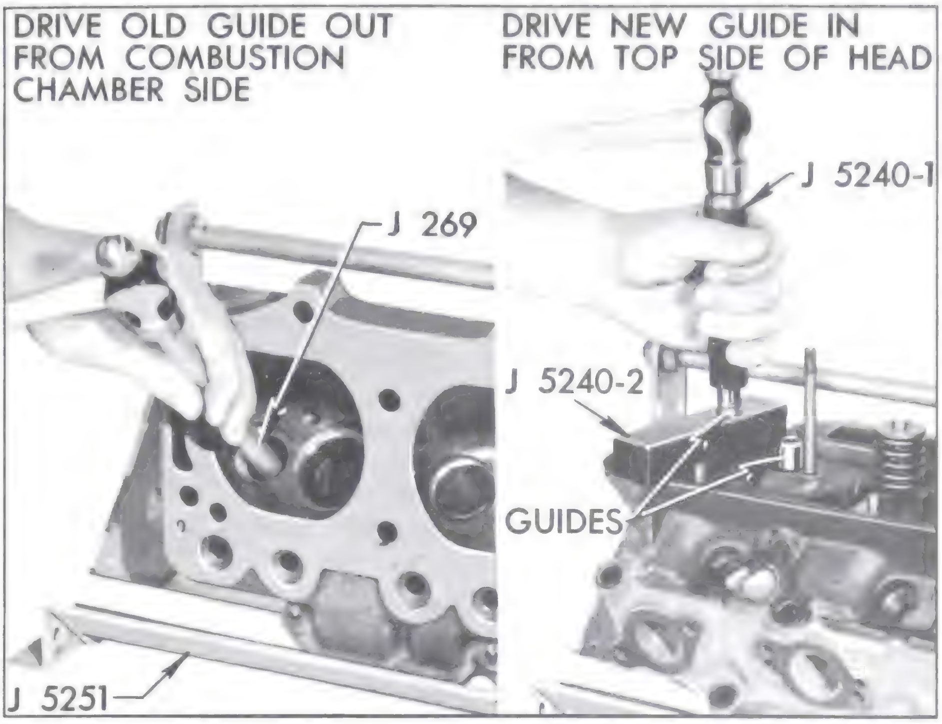


Figure 2-20—Removing and Installing Valve Guide

guides out from combustion chamber side using Driver J-269. See Figure 2-20 on 300 cu. in. engine use J-267.

(b) Place cylinder head on holding fixture with valve cover studs straight up, remove cover gasket and clean gasket surface of head.

(c) Place Valve Guide Aligner J-5240-2 over guide hole in head, insert the valve guide either end down, and use Installer J-5240-1 and hammer to drive guide down into head until the shoulder on the installer contacts top of the aligner. See Figure 2-20. Repeat for each guide.

(d) Use Valve Guide Reamer J-129-3 to finish ream inlet and exhaust guides. Replacement guides are not finish reamed to size On 300 cu. in. engine use Reamer J-8814.

6. Reface valves and true up valve seats to 45 degrees. Cutting a valve seat results in lowering the valve spring pressure and increases the width of the seat. The nominal width of a valve seat is 3/64" to 5/64" (1/16" average). If valve seat is over 5/64" after truing up, it should be narrowed to specified width by using the proper 20 degree and 70 degree cutters.

Improper hydraulic valve lifter operation may result if valve and seat have been refinished enough to allow the end of valve stem to raise approximately .050" above normal position. In this case it will be necessary to grind off end of valve stem or replace parts.

The normal height of the valve stem above the valve rocker arm cover gasket surface of the cylinder head is 1.540.

7. Lightly lap valves into seats with fine grinding compound. The refacing and reseating operations should leave the refinished surfaces smooth and true so that a minimum of lapping is required. Excessive lapping will groove the valve face and a grooved valve will not seat tightly when hot.

8. Test valves for concentricity with seats and for tight seating. Valves usually are tested by lightly coating the valve face with prussian blue and turning the valve against its seat. This indicates whether the seat is concentric with the valve guide but does not prove that valve face is concentric with the valve stem, or that the valve is seating all the way around. After making this test, wash all blue from surfaces, lightly coat valve seat with blue and repeat the test to see whether a full mark is obtained on the valve. Both tests are necessary to prove that a proper seat is being obtained.

9. Reinstall center crossbar in holding fixture, install valves in guides, then install valve springs, caps and keys. Place ends of springs having closed coils against cylinder head.

c. Replacement of Rocker Arms (401 & 425 cu. in. Engines)

1. Remove cotter pin, flat washer and spring washer from each end of the rocker arm shaft and remove bolts from brackets. Remove rocker arms, brackets and springs from shaft.

2. Clean and inspect all parts and replace those that are excessively worn.

3. Assemble springs, rocker arms and brackets on shaft as shown in Figure 2-21. Note that the long spring is at middle of shaft, the valve ends of all rocker arms slant toward middle of

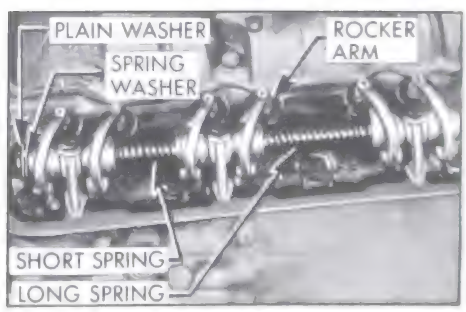


Figure 2-21—Rocker Arm and Shaft Assembly

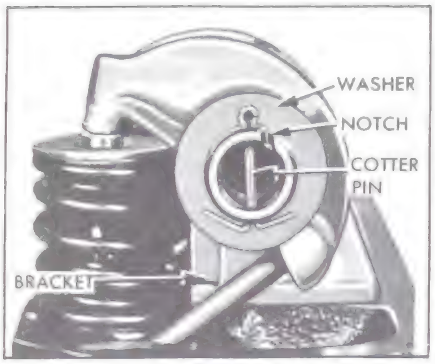


Figure 2-22—Rocker Arm Shaft End View

shaft, and a bracket is located between each pair of rocker arms.

4. Install spring washer, flat washer, and cotter pin on each end of shaft in the order named.

5. Install bolts with plain washers through brackets and shaft so that the notch on one end of shaft is upward in line with bolt heads. This places the oil holes on lower side of shaft in proper relationship to rocker arms. See Figure 2-22.

Figure 2-23—Rocker Arm Shaft Installation

d. 300 cu. in. Engine

Install bolts with plain washers through the brackets and shaft so the notch in the right assembly is up and to the front and the notch in the left assembly is up and to the rear. See Figure 2-23.

e. Installation of Cylinder Head (401 & 425 cu. in. Engine)

Make certain that gasket surfaces and all parts are absolutely clean, then install cylinder head by reversing the procedure for removal, paying particular attention to the following points.

(1) When handling thin crimped steel gaskets use care to prevent damage to the lacquered surface coat and to prevent kinking at sealing rings stamped in gasket. The lacquered gasket should not be coated with any type of sealing material when installed. <u>Always use a new steel gasket because the stamped sealing rings are flattened in a used gasket.</u>

(2) Right and left cylinder heads are identical except that the water inlet port is open at front end and is plugged at rear end as installed on engine.

(3) After installation of cylinder head, tighten all bolts a little at a time about three times around in sequence shown in Figure 2-24, then finally tighten in same sequence to 65-75 ft. lbs. torque.

Always use an accurate torque wrench when tightening cylinder head bolts, to insure uniform and proper torque on all bolts. Uneven or excessively tightened bolts may distort cylinder bores, causing compression loss and excessive oil consumption.

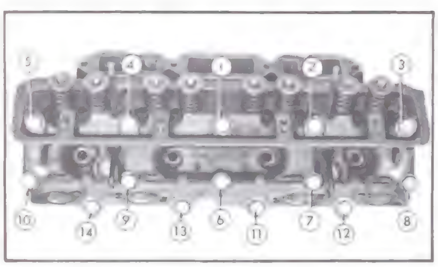


Figure 2-24—Cylinder Head Bolt Tightening Sequence

(4) Install locking plates with exhaust manifold bolts, tighten bolts only to 10-15 ft. lbs. torque, then bend one tab of plate against a flat on each bolt head.

(5) When rocker arm and shaft assembly is installed, make certain that the notch in one end of shaft is upward in line with bracket bolt heads. See Figure 2-22.

(6) Install intake manifold gaskets so pointed end of each gasket is "IN" toward center of engine.

(7) After installation is completed and engine has been warmed up to operating temperature, recheck cylinder head bolts for 65-75 ft. lbs. torque.

f. Installation of Cylinder Head (300 cu. in. Engine)

CAUTION: <u>Aluminum parts can be damaged by careless handling. Be particularly careful of gasket surfaces.</u>

1. Wipe off engine block gasket surface and be certain no foreign material has fallen in the cylinder bores, bolt holes, or in the valve lifter area. It is good practice to clean out bolt holes with an air hose.

2. Install new head gasket on cylinder block. Dowels in the block will hold the gasket in position. Always handle gaskets carefully to avoid kinking or damage to the surface treatment of the gasket. Do not use any type of sealing material on head gaskets. The gaskets are coated with a special lacquer to provide a good seal, once the parts have warmed up.

3. Assemble exhaust manifold to cylinder head with bolts and locking plates as shown in Figure 2-25. Torque bolts to 10-15 ft. lbs.

NOTE: Automatic transmission filler tube bracket fastens to rear bolt, right side.

4. Clean gasket surface of cylinder head and carefully set in place on the engine block dowel pins.

5. Clean and lubricate the head bolts with "Perfect Seal" sealing compound. Install bolts as shown in Figure 2-26.

6. Tighten the head bolts a little at a time about three times around in the sequence shown in Figure 2-26, then torque the bolts in the same sequence to 65-70 ft. lbs.

NOTE: Damage to the cylinder block threads can result if bolts are not lubricated with "Perfect Seal" prior to installation, or if the bolts are tightened excessively.

Use an accurate torque wrench when installing head bolts and do not overtighten. Uneven tightening of the cylinder head bolts can distort the cylinder bores, causing compression loss and excessive oil consumption.

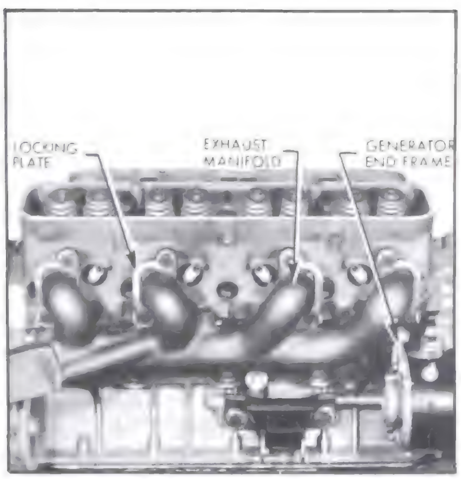


Figure 2-25—Exhaust Manifold Installation

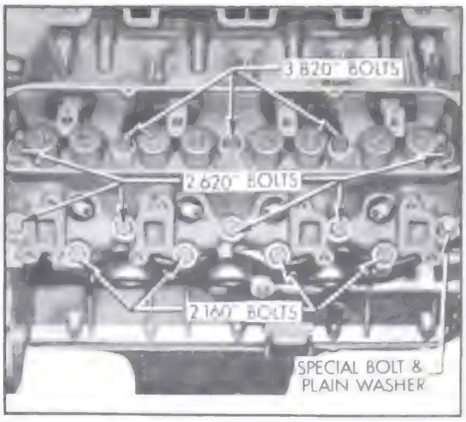


Figure 2-26—Cylinder Head Bolt Installation

2-14 HYDRAULIC VALVE LIFTER SERVICE

a. Removal of Valve Lifters

1. Remove air cleaner and silencer, then disconnect all pipes from carburetor and intake manifold.

2. Disconnect wires from the accelerator vacuum switch and remove the throttle return spring. Remove ignition coil and equalizer shaft bracket from intake manifold and move these parts out of the way.

3. Remove intake manifold and carburetor as an assembly. Remove manifold gaskets.

4. With air hose and cloths, clean dirt from cylinder heads, valve lifter cover and adjacent area to avoid getting dirt into engine. It is extremely important to avoid getting dirt into the hydraulic valve lifters.

5. Remove rocker arm cover, rocker arm and shaft assembly, and push rods from bank where valve lifters are to be removed.

6. Remove valve lifter cover and remove the valve lifters that require service. Place lifters in a wooden block having numbered holes or used other suitable method of identifying them according to original position in engine.

If less than a full set of lifters is being removed, immediately disassemble and inspect one or two for presence of dirt or varnish (subpar. c). If lifters contain dirt or varnish it is advisable to remove all lifters for cleaning and inspection; otherwise it will be satisfactory to service only those lifters that are not operating properly.

7. Examine the cam contact surface at lower end of each lifter body. If this surface is excessively worn, galled, or otherwise damaged discard the lifter assembly. In this case also examine the mating camshaft lobe for excessive wear or damage.

b. Cleaning Tank J-5093 and Cleaning Fluids

Cleaning Tank J-5093 is designed to permit a systematic and thorough cleaning of hydraulic valve lifter parts. It provides three compartments for cleaning fluids, two 16-compartment cleaning trays, one small tray for special tools and a removable cover. The two cleaning trays allow one set of lifters to be soaking while another set is being worked on. The cover, placed on bench in front of tank, provides an easily cleaned working surface. See Figure 2-27.

The left hand compartment of tank is for cleaning solvent in which parts are soaked after disassembly. The solvent required should either dissolve the varnish deposit on lifter parts or soften the varnish so that it can be removed by wiping, after soaking for not longer than one hour. Gulf Motor Flush, or an equivalent solvent, will effectively clean lifter parts.

When selecting a cleaning solvent, careful consideration should

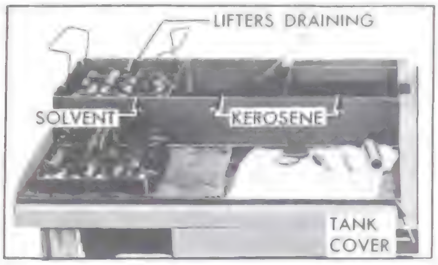


Figure 2-27—Tank J-5093 Set Up for Cleaning Lifter Parts

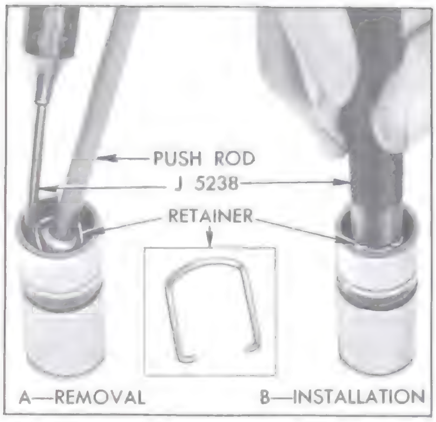


Figure 2-28—Removing and Installing Plunger Retainer

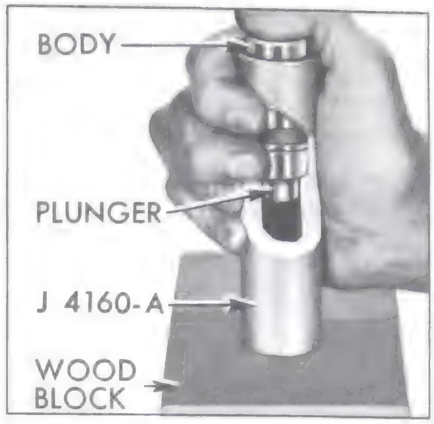


Figure 2-29—Removing Stuck Plunger with J-4160-A

be given to its effect upon the hands. The directions and safety precautions of the manufacturer should be understood and observed to avoid personal injury. A wise safety rule is to wear rubber gloves when handling parts that are wet with cleaning solvent.

The middle compartment of tank is for clean kerosene to be used for cleaning parts after removal from the cleaning solvent. The right hand compartment is for clean kerosene to be used exclusively for final rinsing of parts just before assembly.

When the cleaning tank is not being used the cover should be installed to exclude dirt from the cleaning fluids. As a further precaution, do not use the tank for any parts except hydraulic valve lifters.

To avoid early contamination and deterioration of the cleaning solvent a separate pan of suitable size should be provided so that a tray of lifter parts can be flushed in kerosene before it is placed in the solvent.

c. Disassembly and Cleaning of Lifters

1. Disassemble each valve lifter by using a push rod to hold down the push rod seat while removing the plunger retainer from the lifter body, using Retainer Remover J-5238. See Figure 2-28, View A. Remove push rod seat and plunger from lifter body.

1a. If a plunger sticks in lifter body place lifter in large end of Plunger Remover J-4160-A, with plunger inward. While holding lifter with thumb, rap the open end of remover against a block of wood with just enough force to jar the plunger from body. See Figure 2-28.

2. Drain oil out of body into a waste can and then remove the ball, retainer and spring. A strainer placed over waste can will prevent dropping these parts into can.

3. Place all parts of each lifter in a separate compartment of a tray from Cleaning Tank J-5093. The body and plunger are selectively fitted to each other and must not be interchanged with parts of other lifters. Keeping all parts of the lifter together until cleaned and inspected will aid in diagnosing cause of improper operation.

4. Rinse the tray full of lifter parts in a pan of kerosene to remove as much oil as possible. This will reduce contamination of the cleaning solvent and extend its effective life.

5. Submerge the tray and parts in the cleaning solvent in left hand compartment of Cleaning Tank J-5093 and leave to soak for approximately one hour. The time required will depend on the varnish on lifter parts and the effectiveness of the solvent.

6. After the varnish has dissolved or has softened sufficiently to permit removal by wiping, raise the tray and suspend it above the solvent by means of the hooks on tray handles. Allow tray and parts to drain so that solvent will be saved.

7. Rinse the tray of parts in the pan of kerosene to cut the solvent and avoid injury to hands, then place tray on the tank cover located on bench in front of cleaning tank.

8. Working on one lifter at a time and using CLEAN lint-free cloths, thoroughly wipe off all parts. Clean the plunger and the external and internal surfaces of the body with a hard wiping action to remove any varnish deposits. Rinse the parts in the kerosene contained in the middle compartment of cleaning tank, using Cleaning Brush J-5099 in the bore of lifter body.

NOTE: To insure absolute cleanliness of a reconditioned lifter assembly, it is advisable to inspect and assemble each (lifter subpar. d, e, f) before cleaning the next lifter.

d. Inspection of Hydraulic Lifter Parts

(1) Lifter Body. Inspect inner and outer surfaces of body for blow holes and scoring. Replace lifter assembly if body is roughly scored or grooved, or has a blow hole extending through the wall in position to permit oil leakage from lower chamber. The promiment wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored; it is caused by side thrust of cam against body while the lifter is moving vertically in its guide.

Inspect the cam contact surface on lower end of lifter body. Replace the lifter assembly if this surface is excessively worn, galled, or otherwise damaged. A lifter body that has been rotating will have a round wear pattern and a non-rotating lifter body will have a square wear pattern with a very slight depression near the center. Either condition is normal and such bodies may be continued in use if the surface is free of defects. See Figure 2-30.

(2) Lifter Plunger. Using a magnifying glass, inspect the check ball seat for defects. Inspect outer surface of plunger for scratches or scores. Small score marks with a rough, satiny finish will cause the plunger to seize when hot but operate normally when cool. Defects in check ball seat or scores or scratches on outer surface of plunger which may be felt with a fingernail are causes for replacing the lifter assembly. This rule does not apply to the slight edge which may sometimes be present where the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred.

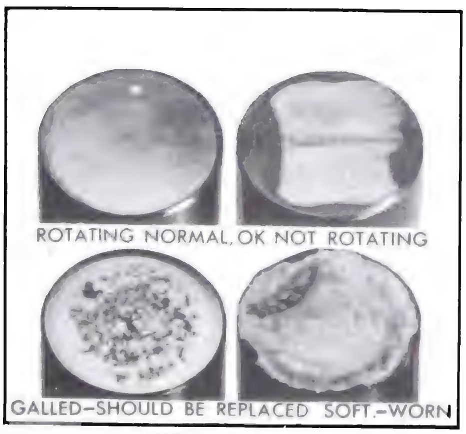


Figure 2-30—Lifter Body Wear Patterns

A blackened appearance is not a defective condition. Sometimes the discoloration serves to highlight slight grinder chatter marks and give the outer surface of plunger a ridged or fluted appearance. This condition will not cause improper operation, therefore it may be disregarded.

(3) Push Rod and Seat. Replace the push rod seat if the area where the push rod contacts is rough or otherwise damaged. Replace any push rod having a rough or damaged ball end.

(4) Check Ball. Using a magnifying glass, carefully examine the check ball for nicks, imbedded material or other defects which would prevent proper seating. Such defects would indicate the cause of intermittently noisy lifter operation. Even though no defects are found it is always advisable to discard the old ball and use a new one when reassembling the lifter.

(5) Ball Retainer. Replace a retainer which is cracked or which has a heavily pounded area between the two holes. A small bright spot where the ball contacts the retainer is the normal condition.

(6) Plunger Spring. Replace the plunger spring only if it is distorted or damaged. Exhaustive tests have shown that plunger springs seldom break down in service.

e. Check Ball Travel

Any ball retainer now used will hold ball travel within satisfactory limits unless the retainer is badly worn or damaged. Therefore, it is not necessary to measure travel of the check ball.

f. Assembly of Hydraulic Lifters

All parts must be absolutely clean when a hydraulic lifter is assembled. Lint and dust may adhere to the parts if they are blown off or wiped with cloths; therefore they should be rinsed in CLEAN kerosene and assembled without drying.

1. Rinse lifter plunger in the kerosene in middle compartment of cleaning tank and then give it a thorough final rinsing in the kerosene in right compartment.

2. Hold plunger in vertical position with feed hole up, then rinse and install the check ball, ball retainer, spring, and body over the plunger. See parts in Figure 2-31.

3. Rinse push rod seat and plunger retainer, place these parts in end of body and depress with handle of Remover J-5238 until retainer engages groove in body. See Figure 2-28, View B.

4. Wrap the lifter in clean paper or otherwise protect it from dirt

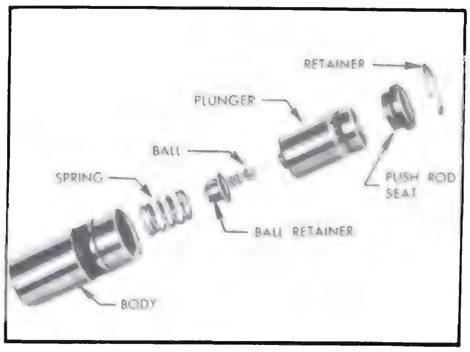


Figure 2-31—Hydraulic Valve Lifter Parts

while reconditioning the other valve lifters, preparatory to testing all lifters for leakdown rate.

g. Testing Lifter Leakdown Rate

After a hydraulic lifter has been cleaned, inspected, and assembled it must be tested before it is installed in an engine. Lifter Test Fixture J-5095 has been designed to test the leak-down rate of a lifter to determine whether it is within limits which assure satisfactory lifter operation.

The following procedure must be carefully followed to obtain an accurate test.

1. Thoroughly clean the cup of test fixture, install cup on fixture, and fill it to within 1/2" of the top with "Hydraulic Lifter Test Fluid," which is available through Kent-Moore Organization, Inc. under K-M number J-5268.

2. Remove rubber washer (used for larger lifters) and install Gauge Sleeve J-5180-5 in the cup; also install Buick V-8 Gauge Rod Nose J-5180-15 in the ram.

3. Swing the weight arm up out of the way, raise the ram and place the valve lifter (top side up) in Sleeve J-5180-5. The lifter must be completely covered by the fluid during test.

4. Lower the ram to rest in the lifter push rod seat, then lower the weight arm to rest on the roller or ram as shown in Figure 2-32.

5. Operate the lifter plunger through its full travel to force all air out of the lifter by using a vigorous pumping action on the weight arm. Continue the pumping action until considerable resistance is built up in the lifter and a definite grab point is felt at the top of the stroke, when the indicator pointer is at the bottom of the scale.

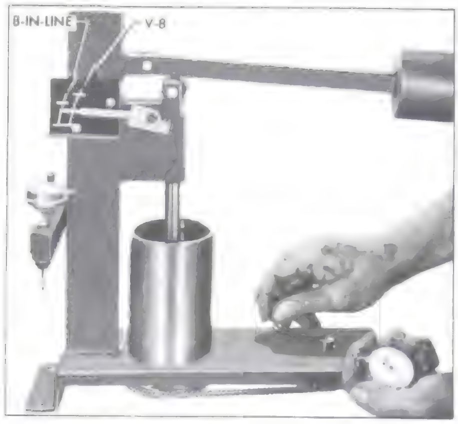


Figure 2-32—Checking Leakdown Rate

Finally, pump vigorously for approximately 10 additional strokes to make sure all air is removed from the lifter. NOTE: If one stroke offers noticeable weak resistance during the last 10 pumping strokes replace the check ball in lifter and repeat the leakdown test to this point.

6. Raise weight arm to allow the lifter plunger to come up to its retainer, then lower the arm to rest on the ram roller. As the pointer starts moving upward start rotating the fluid cup by turning the handle one revolution every two seconds. See Figure 2-32.

7. Use a stop watch to check the time required for the pointer to move from the lower to the upper mark on scale where marked "BUICK V-8." The cup must be rotated during this test. See Figure 2-32.

8. The leak-down rate (time between marks) must be between 12 and 40 seconds to assure satisfactory lifter performance. A doubtful lifter should be tested three or four times. Replace any lifter which does not test within the specified limits.

9. After all lifters have been tested, place the cover over the test fixture to keep dirt out of the cup and fluid. The fluid should be discarded and the cup should be thoroughly cleaned after a few sets of lifters have been tested.

h. Installation of Valve Lifters

Make certain that valve lifter guide holes and adjacent area of cylinder block are clean, then oil and install valve lifters. Each lifter must slide freely in its guide hole; if a lifter is tight in one guide hole fit it to another hole.

Complete the installation of all parts by reversing the procedure for removal. An initial adjustment for clearance is not required, therefore, the valve train does not have any provision for adjustment after assembly.

2-15 TIMING CHAIN COVER AND CAMSHAFT SERVICE

A. 401 and 425 cu. in. Engine

a. Remove and Install Timing Chain

1. Drain engine cooling system, then remove radiator core, shroud (if so equipped), fan belt, fan and pulley, and crankshaft balancer.

2. Remove all bolts that attach the timing chain cover and the water manifold to the upper and lower crankcase and the cylinder heads. Do not remove five bolts attaching water pump to chain cover. Remove cover and manifold, using care to avoid damaging lower crankcase (oil pan) gasket.

3. Remove oil slinger from crankshaft and remove the bolt, lockwasher and plain washer that attaches the fuel pump operating eccentric and the camshaft sprocket to front end of camshaft.

4. If there has been doubt about the valve timing, turn crankshaft until the camshaft sprocket keyway is straight down toward the crankshaft and the "0" timing marks on both sprockets are toward each other and in line with shaft centers. See Figure 2-33.

5. Using two large screwdrivers, alternately work the camshaft and crankshaft sprockets outward until the camshaft sprocket is free of camshaft. Remove this sprocket and timing chain, then remove other sprocket from crankshaft.

6. Thoroughly clean all sludge from timing chain cover and front face of crankcase. Inspect crankshaft oil seal in chain cover and replace if worn (subpar. b, below).

7. When ready to install timing chain, turn crankshaft until Nos. 1 and 4 pistons are on top dead center. Turn camshaft so that the sprocket key points straight down toward crankshaft. See Figure 2-33.

8. Place timing chain over the camshaft and crankshaft sprockets so that the "0" marks stamped on front faces of sprockets are nearest each other and aligned between the sprocket hubs. Install sprockets with chain on the two shafts. See Figure 2-33.

9. If fuel pump operating eccentric is detached from camshaft sprocket, install it so that the keyway fits over key in camshaft, then install plain washer, lockwasher and bolt to hold eccentric and sprocket to camshaft.

10. Install oil slinger on crankshaft with concave side outward then reinstall all parts by reversing the procedure for removal.

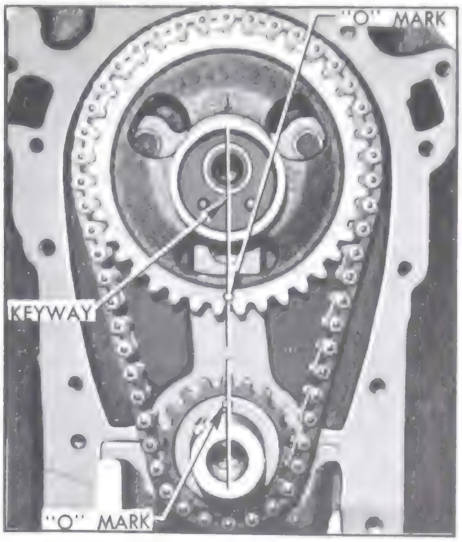


Figure 2-33—Timing Chain and Sprockets Properly Installed

b. Replacement of Crankshaft Oil Seal in Timing Chain Cover

1. With timing chain cover on bench, remove the braided fabric packing with a screwdriver and then tap the pressed steel shedder out of the cover.

2. Work new packing into the shedder, then drive shedder into recess in timing chain cover, using Installer J-5250-1. See Figure 2-34, View A.

3. Push Packing Expander J-5250-2 through the seal to expand the packing into place and size the opening for the crankshaft. See Figure 2-34, View B. Apply a light coat of vaseline to the packing.

c. Camshaft Bearings

The five steel-backed babbitt-lined camshaft bearings are pressed into the crankcase. Going from front to rear, each bearing is bored .030" smaller than the preceding bearing, and each camshaft journal is correspondingly reduced in diameter.

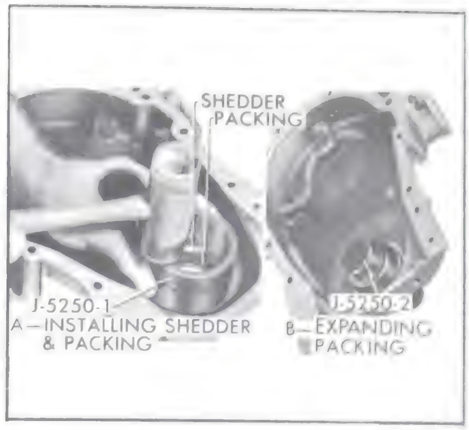


Figure 2-34—Installing Crankshaft Oil Seal

The camshaft bearings must be line reamed to size after being pressed into the crankcase. Since this operation requires special reaming equipment the original bearings should be retained unless severely damaged. Slightly scored camshaft bearings will be satisfactory if the surface of camshaft journals are polished and bearings are cleaned up to remove burrs, and the fit of shaft in bearings is free and within the clearance limits of .0015" to .004".

2-16 TIMING CHAIN, COVER AND CAMSHAFT SERVICE

B. 300 cu. in. Engine

a. Timing Chain Cover Removal

1. Drain radiator and block.

2. Disconnect upper radiator hose and heater return hose at water pump, disconnect lower radiator hose. Remove attaching bolts and brackets and remove radiator core.

3. Remove fan, fan pulleys and belt(s).

4. Remove fan driving pulley (crankshaft) and pulley reinforcement.

5. Remove harmonic balancer to crankshaft bolt and washer 15/16" socket. Remove harmonic balancer. It may be necessary to tap the balancer with a plastic mallet to start it off the crankshaft.

6. If car is equipped with power steering, remove steering pump bracket bolts attached to timing chain cover and loosen or remove other bolts to allow the brackets and pump to be moved out of the way.

7. Disconnect fuel lines and remove fuel pump.

8. Remove Delcotron generator and brackets.

9. Remove distributor cap and pull spark plug wire retainers off brackets on rocker arm cover. Swing distributor cap with wires attached out of the way. Disconnect distributor primary lead.

10. Remove distributor. If timing chain and sprockets are not going to be disturbed, note position of distributor rotor for reinstallation in same position.

11. Loosen and slide front clamp on thermostat by-pass hose rearward.

12. Remove bolts attaching timing chain cover to cylinder block. Remove two oil pan to timing chain cover bolts. Remove timing chain cover assembly and gasket. Thoroughly clean the cover, taking care to avoid damage to the gasket surfaces.

b. Crankshaft Oil Seal Replacement

1. Use a punch to drive out old seal and shedder. Drive from the front toward the rear of the timing chain cover.

2. Coil new packing around opening so ends of packing are at top. Drive in new shedder using suitable punch. Stake the shedder in place in at least three places.

3. Size the packing by rotating a hammer handle or similar smooth tool around the packing till the balancer hub can be inserted through the opening.

c. Timing Chain Cover Replacement

Reinstall timing chain cover by reversing removal procedure, paying particular attention to the following points.

1. Remove oil pump cover and pack the space around the oil pump gears completely full of petroleum jelly. There must be no air space left inside the pump. Reinstall cover using new gasket. This step is very important as the oil pump may "lose its prime" whenever the pump, pump cover or timing chain cover is disturbed. If the pump is not packed, it may not begin to pump oil as soon as the engine is started.

2. The gasket surface of the block and timing chain cover must be smooth and clean. Use a new gasket and be certain it is positioned correctly.

3. Position timing chain cover against block and be certain dowel pins engage dowel pin holes before starting bolts.

4. Lube the bolt threads before installation and install.

NOTE: <u>If the car is equipped with power steering the front steering pump bracket should be installed at this time.</u>

5. Lube the O.D. of the harmonic balancer before installation to prevent damage to the seal during installation and when the engine is first started.

d. Timing Chain and Sprocket Removal

1. With timing chain cover removed (subpar. a above) temporarily install harmonic balancer bolt and washer in end of crankshaft. Turn crankshaft so sprockets are positioned. Doing so will make it easier to reinstall parts. Remove harmonic balancer bolt and washer using a sharp rap on the wrench handle to start the bolt out without changing position of sprockets.

2. Remove front crankshaft oil slinger.

3. Remove bolt and special washer retaining camshaft distributor drive gear and fuel pump eccentric to camshaft forward end. Slide gear and eccentric off camshaft.

4. Use two large screwdrivers to alternately pry the camshaft sprocket then the crankshaft sprocket forward until the camshaft sprocket is free, then remove the camshaft sprocket and chain and finish working crankshaft sprocket off crankshaft.

5. Thoroughly clean the timing chain, sprockets, distributor drive gear, fuel pump eccentric and crankshaft oil slinger.

e. Timing Chain and Sprocket Installation

1. Turn crankshaft so number one piston is at top dead center.

2. Turn camshaft so with sprocket temporarily installed, timing mark is straight down. Remove sprocket.

3. Assemble timing chain on sprockets and slide the sprocket and chain assembly on the shafts with the timing marks in their closest together position and in line with the sprocket hubs.

NOTE: <u>It will be necessary to hold spring loaded timing chain damper out of the way while sliding chain and sprockets into position.</u>

4. Assemble slinger on crankshaft with I.D. against sprocket. (Concave side toward front of engine).

5. Slide fuel pump eccentric on camshaft and Woodruff key with oil groove forward. See Figure 2-36.

6. Install distributor drive gear. See Figure 2-36.

7. Install drive gear and eccentric bolt and retaining washer. Torque to 40-45 ft. lbs.

8. Reinstall timing chain cover (subpar. c above).

f. Camshaft Replacement

1. Remove rocker arm and shaft assemblies, push rods and valve lifters.

2. Remove timing chain cover, timing chain and sprocket subparagraphs a and d above.

3. Slide camshaft forward out of bearing bores carefully to avoid marring the bearing surfaces.

Figure 2-36—Fuel Pump Eccentric and Distributor Drive Gear Installation

4. Replace camshaft by reversing removal procedure, taking particular care to avoid damage to the camshaft bearings.

g. Camshaft Bearings

The steel-backed babbitt-lined camshaft bearings are pressed into the crankcase. Going from front to rear, each bearing is bored. 030" smaller than the preceding bearing, and each camshaft journal is correspondingly reduced in diameter.

The camshaft bearings must be line reamed to size after being pressed into the crankcase. Since this operation requires special reaming equipment the original bearings should be retained unless severly damaged. Slightly scored camshaft bearings will be satisfactory if the surfaces of camshaft journals are polished and bearings are cleaned up to remove burrs, and the fit of shaft in bearings is free and within the clearance limits of .0015" to .004".

SECTION 2-E

REPLACEMENT OF CRANKSHAFT AND CONNECTING ROD BEARINGS, PISTONS AND RINGS

CONTENTS OF SECTION 2-E

2-17 REPLACEMENT OF CONNECTING ROD BEARINGS

A connecting rod bearing consists two halves or shells which are alike and interchangeable in rod and cap. When the shells are placed in rod and cap the ends extend slightly beyond the parting surfaces so that when rod bolts are tightened the shells will be clamped tightly in place to insure positive seating and to prevent turning. The ends of shells must never be filed flush with parting surface of rod or cap.

If a precision type connecting rod bearing becomes noisy or is worn so that clearance on crankpin is excessive, a new bearing of proper size must be selected and installed since no provision is made for adjustment. Under no circumstances should the connecting rod or cap be filed to adjust the bearing clearance.

a. Inspection of Connecting Rod Bearings and Crankpin Journals

After removal of lower crankcase, disconnect two connecting rods at a time from crankshaft and inspect the bearings and crankpin journals. While turning crankshaft it is necessary to temporarily reconnect the rods to crankshaft to avoid possibility of damaging the journals through contact with loose rods.

If connecting rod bearings are chipped or scored they should be replaced. If bearings are in good physical condition check for proper clearance on crankpins as described in subparagraph b, below.

If crankpin journals are scored or ridged the crankshaft must be replaced, or reground for undersize bearings, to insure satisfactory life of connecting rod bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil. Burrs may be honed off with a fine oil stone.

Use an outside micrometer to check crankpins for out-of-round. If crankpins are more than .0015" out-of-round, satisfactory life of new bearings cannot be expected.

b. Checking Clearance and Selecting Replacement Connecting Rod Bearings

Service bearings are furnished in standard size and several undersizes (including undersizes for reground crankpins).

The clearance of connecting rod (and crankshaft) bearings may be checked by use of Plastigage, Type PG-1 (green), which has a range of .001" to .003". Plastigage is manufactured by Perfect Circle Corporation, and is available through General Motors parts warehouses.

1. Remove connecting rod cap with bearing shell. Wipe oil from bearing and crankpin journal, also blow oil out of hole in crankshaft. NOTE; Plastigage is soluble in oil.

2. Place a piece of Plastigage lengthwise along the bottom center of the lower bearing shell (Figure 2-37, view A), then install cap with shell and tighten bolt nuts to 40-45 ft. lbs. torque.

NOTE: The rib on edge of cap and the conical boss on web of rod must be toward rear of engine on all rods in right bank or toward front of engine in left bank.

3. DO NOT TURN CRANKSHAFT with Plastigage in bearing.

4. Remove bearing cap with bearing shell, the flattened Plastigage will be found adhering to either the bearing shell or the crankpin. Do not remove it.

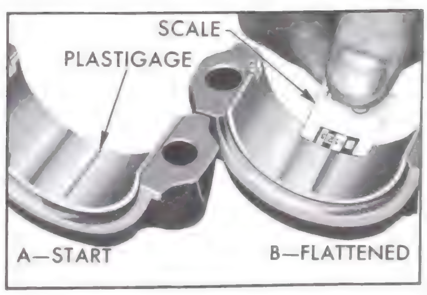


Figure 2-37—Checking Bearing Clearance with Plastigage

5. Using the scale printed on the Plastigage envelope, measure the flattened Plastigage at its widest point. The number within the graduation which most closely corresponds to the width of Plastigage indicates the bearing clearance in thousandths of an inch. See Figure 2-37, View B.

6. The desired clearance with a new bearing is .0002" to .0023". If bearing has been in service it is advisable to install a new bearing if the clearance exceeds .003"; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

7. If a new bearing is being selected, try a standard size, then each undersize bearing in turn until one is found that is within the specified limits when checked for clearance with Plastigage. NOTE: Each undersize bearing shell has a number stamped on outer surface on or near the tang to indicate amount of undersize. See Figure 2-38.

8. After the proper size bearing has been selected, clean off the Plastigage, oil the bearing thoroughly, reinstall cap with bearing shell and tighten bolt nuts to 40-45 ft. lbs. torque. See NOTE in Step 2.

Figure 2-38—Location of Undersize Mark on Bearing Shell

9. With selected bearing installed and bolts tightened, it should be possible to move connecting rod freely back and forth on crankpin as allowed by end clearance. If rod cannot be moved, either the bearing is too much undersize or a misaligned rod is indicated.

2-18 REPLACEMENT OF CRANKSHAFT BEARINGS

A crankshaft bearing consists of two halves or shells which are alike and interchangeable in cap and crankcase. The first four bearings are identical, but the rear bearing is longer and flanged to take crankshaft end thrust. When the shells are placed in crankcase and bearing cap the ends extend slightly beyond the parting surfaces so that when cap bolts are tightened the shells will be clamped tightly in place to insure positive seating, and to prevent turning. The ends of shells must never be filed flush with parting surface of crankcase or bearing cap.

If a thrust bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel several times with the bearing cap bolts finger tight.

Crankshaft bearings are the precision type which do not require reaming to size or other fitting. Shims are not provided for adjustment since worn bearings are readily replaced with new bearings of proper size. Bearings for service replacement are furnished in standard size and undersizes. Under no circumstances should crankshaft bearing caps be filed to adjust for wear in old bearings.

a. Inspection of Crankshaft Bearings and Crankshaft

After removal of lower crankcase, oil pump and bell housing cover perform the following removal, inspection and installation operations on each crankshaft bearing in turn so that the crankshaft will be well supported by the other bearings.

NOTE: If crankshaft has been removed to check straightness the following procedure is suggested.

Rest crankshaft on "veeblocks" at number one and number five main bearing journals. Check indicator runout at No. 2, 3 and 4 main bearing journals. Total indicator readings at each journal should not exceed .003".

While checking runout at each journal note relation of "high" spot (or maximum eccentricity) on each journal to the others. "High" spot on all journals should come at the same angular location. If "high" spots do not come at nearly the same angular location, crankshaft has a "crook" or "dogleg" in it and is unsatisfactory for service.

1. Since any service condition which affects the crankshaft bearings may also affect the connecting rod bearings, it is advisable to inspect connecting rod bearings first (par. 2-17). If crankpins are worn to the extent that crankshaft should be replaced or reground, replacement of crankshaft bearings only will not be satisfactory.

2. Remove one bearing cap, then clean and inspect lower bearing shell and the crankshaft journal. If journal surface is scored or ridged, the crankshaft must be replaced or reground to insure satisfactory operation with new bearings. Slight roughness may be polished out with fine grit polishing cloth thoroughly wetted with engine oil, and burrs may be honed off with a fine stone.

3. If condition of lower bearing shell and crankshaft journal is satisfactory, check the bearing clearance with Plastigage as described for connecting rod bearings in paragraph 2-17.

4. When checking a crankshaft bearing with Plastigage, turn crankshaft so that oil hole is up to avoid dripping of oil on Plastigage. Place paper shims in lower halves of adjacent bearings and tighten cap bolts to take the weight of crankshaft off the lower shell of bearing being checked. NOTE: Arrow on cap must point to front of engine.

5. If bearing clearance exceeds .0036", it is advisable to install a new bearing; however, if bearing is in good condition and is not being checked because of bearing noise, it is not necessary to replace the bearing.

b. Selection and Installation of a New Crankshaft Bearing

1. Loosen all crankshaft bearing cap bolts 1/2 turn, and remove cap of bearing to be replaced.

2. Remove upper bearing shell by inserting Bearing Shell Remover and Installer J-8080 in oil hole in crankshaft, then slowly turning crankshaft so that the tool rotates the shell out of place by pushing against the end without the tang. See Figure 2-30. CAUTION: When turning crankshaft with rear bearing cap removed hold oil seal to prevent it from rotating out of position in crankcase.

3. The crankshaft journal cannot be measured with an outside micrometer when shaft is in place; however, when upper bearing shell is remove the journal may be checked for out-of-round by using a special crankshaft caliper and inside micrometer. The caliper should not be applied to journal in line with the oil hole.

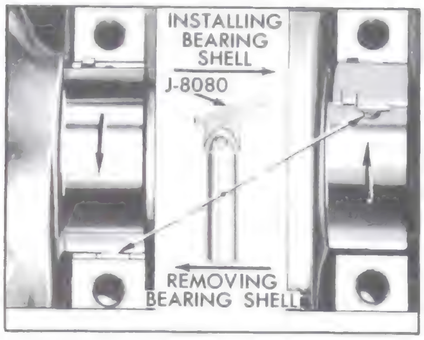


Figure 2-39—Removing and Installing Crankshaft Bearing Upper Shell

If crankshaft journal is more than .0015" out-of-round, the crankshaft should be replaced since the full mileage cannot be expected from bearings used with an excessively out-of-round crankshaft.

4. Before installation of bearing shells make sure that crankshaft journal and the bearing seats in crankcase and cap are thoroughly cleaned.

5. Coat inside surface of upper bearing shell with engine oil and place shell against crankshaft journal so that tang on shell will engage notch in crankcase when shell is rotated into place.

6. Rotate bearing shell into place as far as possible by hand, then insert Installer KMO-734 in crankshaft oil hole and rotate crankshaft to push shell into place. CAUTION: Bearing shell should move into place with very little pressure. If heavy pressure is required, shell was not started squarely and will be distorted if forced into place.

7. Place lower bearing shell in bearing cap, then check clearance with Plastigage as previously described.

8. The described clearance with a new bearing is .0005" to .0025". If this clearance cannot be obtained with a standard size bearing, insert an undersize bearing and check again with Plastigage. NOTE: Each undersize shell has a number stamped on outer surface on or near the tang to indicate amount of undersize. See Figure 2-38.

9. When the proper size bearing has been selected, clean out all Plastigage, oil the lower shell and reinstall bearing cap. Tighten cap bolts to 100-110 ft. lbs. The crankshaft should turn freely at flywheel rim; however, a very slight drag is permissable if an undersize bearing is used.

10. If a thrust bearing shell is disturbed or replaced it is necessary to line up the thrust surfaces of the bearing shell before the cap bolts are tightened. To do this, move the crankshaft fore and aft the limit of its travel several times with the thrust bearing cap bolts finger tight.

11. After bearing is installed and tested, loosen all bearing cap bolts 1/2 turn and continue with other bearings. When bearings have been installed and tested, tighten all bearing cap bolts to 100-110 ft. lbs. torque.

c. Installation of Rear Bearing Oil Seals

Braided fabric seals are pressed into grooves formed in crankcase and rear bearing cap to rear of the oil collecting groove, to seal against leakage of oil around the crankshaft

Neoprene composition seals are placed in grooves in the sides of bearing cap to seal against leakage in the joints between cap and crankcase. The neoprene composition swells in the presence of oil and heat. The seals are undersize when newly installed and may even leak for a short time until the seals have had time to swell and seal the opening. See Figure 2-40.

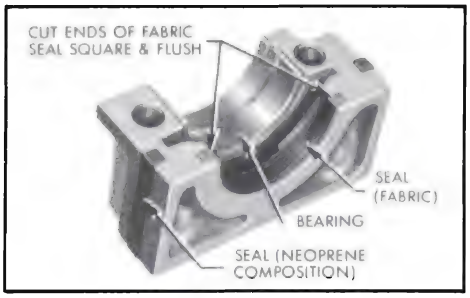


Figure 2-40—Rear Bearing Oil Seals

The braided fabric seal can be installed in crankcase only when crankshaft is removed; however, the seal can be replaced in cap whenever cap is removed. Remove old seal and place new seal in groove with both ends projecting above parting surface of cap. Force seal into groove by rubbing down with hammer handle or smooth stick until seal projects above the groove not more than 1/16". Cut ends off flush with surface of cap, using sharp knife or razor blade. See Figure 2-32. CAUTION: The engine must be operated at slow speed when first started after new braided seal is installed.

The neoprene composition seals are slightly longer than the grooves in the bearing cap. The seals must not be cut to length. Just before installation of bearing cap in crankcase, lightly lubricate the seals and install in bearing cap with upper end protruding approximately 1/16". After cap is installed, force seals up into the cap with a blunt instrument to be sure of a seal at the upper parting line between the cap and case.

d. Installation of Oil Pump and Lower Crankcase

1. Install oil pump assembly, following procedure given in paragraph 2-24 to avoid binding.

2. Thoroughly clean lower crankcase and flywheel lower housing or bell housing cover before installation. Use new gaskets when installing lower crankcase and flywheel lower housing.

3. When reconnecting steering linkage, follow instructions outlined in paragraph 8-21.

2-19 REPLACEMENT OF PISTONS, RINGS AND CONNECTING RODS

a. Removal and Disassembly of Piston and Rod Assemblies

1. Remove cylinder heads (par. 2-14, a), lower crankcase and oil and vacuum pump.

2. Examine the cylinder bores above the ring travel. If bores are worn so that a shoulder or ridge exists at this point, remove ridges with a ridge reamer to avoid damaging rings or cracking ring lands in pistons during removal. Chamfering at 15 degree angle will prevent ring damage when pistons are reinstalled.

3. Use a silver pencil or quick drying paint to mark the cylinder number on all pistons, connecting rods and caps. Starting at front end of crankcase, the cylinders in right hand bank are numbered 1, 3, 5, 7 and in left bank are numbered 2, 4, 6, 8.

4. With No. 1 crankpin straight down, remove the cap with bearing shell from No. 1 connecting rod, then install the short Connecting Rod Bolt Guide J-5239-1 on the lower connecting rod bolt, and install the long Guide J-5239-2 on the opposite bolt, above crankpin. Turn guides down to hold the bearing upper shell in place. See Figure 2-41.

5. Use the long guide to push the piston and rod assembly out of the cylinder, then remove guides and reinstall cap with bearing shell on rod.

Figure 2-41—Connecting Rod Bolt Guides Installed

6. Remove all other piston and rod assemblies in the same manner.

7. Remove compression rings using Ring Expander KMO-232. Then remove oil ring by removing the two rails, spacer, and expander which are separate pieces in each piston third groove. See Figure 2-38.

8. Place piston and rod assembly in press. Using Piston Support J-6047-17 (with full radial face up) under the piston, place Drive Pin J-6047-4 in upper end of piston pin and press pin from rod and piston. Guide Pin J-6047-16 is not used during pin removal.

b. Inspection of Cylinder Bores

Inspect cylinder walls for scoring, roughness, or ridges which indicate excessive wear. Check cylinder bores for taper and out-of-round with an accurate cylinder gauge at top, middle, and bottom of bore, both parallel and at right angles to centerline of engine. The diameter of cylinder bore at any point may be measured with an inside micrometer, or Telescope Gauge and measuring across the gauge contact points with outside micrometer.

If a cylinder bore is moderately rough or slightly scored but is

not out-of-round or tapered, it usually is possible to remedy the condition by honing the bore to fit a standard service piston, since standard service pistons are of high limit diameters. If cylinder bore is very rough or deeply scored, however, it may be necessary to rebore the cylinder and fit an oversize piston in order to insure satisfactory results.

If cylinder bore is tapered .005" or more, or is out-of-round .003" or more, it is advisable to rebore for the smallest possible oversize pistons and rings. With this amount of bore wear, some piston wear has usually taken place so that the total clearance in the ring travel will be sufficient to produce noisy piston operation.

c. Inspection of Pistons, Rings and Pins

Clean carbon from piston surfaces and under side of piston heads. Clean carbon from ring grooves with suitable tool and remove any gum or varnish from piston skirts with suitable solvent.

Carefully examine pistons for rough or scored bearing surfaces, cracks in skirt or head, cracked or broken ring lands, chipping or uneven wear which would cause rings to seat improperly or have excessive clearance in ring grooves. Damaged or faulty pistons should be replaced.

The pistons are cam ground, which means that the diameter at a right angle to piston pin is greater than the diameter parallel to piston pin. When a piston is checked for size it must be measured with a micrometer applied to skirt at points exactly 90 degrees to piston pin. See Figure 2-42. Measurements should be made at top and bottom ends of skirt; the diameter at top end will normally be very slightly less than at bottom end after a

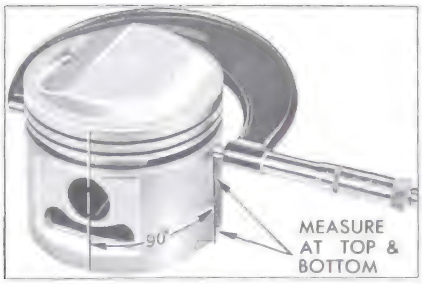


Figure 2-42—Measuring Piston with Micrometer

piston has been in service in an engine.

Inspect bearing surfaces of piston pins and check for wear by measuring worn and unworn surfaces with micrometers. Rough or worn pins should be replaced. Test fit of piston pins in piston bosses. Sometimes pins will be found tight due to gum or varnish deposits. This may be corrected by removing the deposit with a suitable solvent.

If piston bosses are worn out of round or oversize, the piston and pin assembly must be replaced. Oversize pins are not practical with the pressed pin and rod assemblies. Piston pins must fit pistons with an easy finger push fit at 70°F. (.00005" - .0001").

Examine all piston rings for scores, chips, or cracks, and for tension as compared with new rings. Place all compression rings in cylinder bores at lower end of ring travel and check gaps, which are normally .010" to .020". If gaps are excessive it indicates that rings have worn considerably and should be replaced.

d. Reboring Cylinders and Fitting New Pistons

If one or more cylinder bores are rough, scored, or worn beyond limits prescribed under Inspection of Cylinder Bores (subpar. b), it will be necessary to smooth or true up such bores to fit new pistons.

If relatively few bores require correction it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance, since all over-size service pistons are held to the same weights as standard size pistons. If conditions justify replacement of all pistons, however, all new pistons should be the same nominal size.

Standard size service pistons are high limit or maximum diameter; therefore, they can usually be used with a slight amount of honing to correct slight scoring or excessive clearances in engines having relatively low mileage. Service pistons are also furnished in .001", .005", .010", .020" and .030" oversizes. All service pistons are diamond bored and selectively fitted with pistons pins; pistons are not furnished without pins.

<u>No attempt should be made to cut down oversize pistons to fit cylinder bores as this will destroy the surface treatment and affect the weight.</u> The smallest possible oversize service pistons should be used and the cylinder bores should be honed to size for proper clearances.

Before the honing or reboring operation is started, measure all new pistons with micrometer contacting at points exactly 90 degrees to piston pin (Figure 2-43) then select the smallest piston for the first fitting. The slight variation usually found between pistons in a set may provide for correction in case the first piston is fitted too free.

If wear at top of cylinder does not exceed .005" on the diameter or exceed .003" out of round, honing is recommended for truing the bore. If wear or out of round exceeds these limits, the bore should be trued up with a boring bar of the fly cutter type, then finish honed.

When reboring cylinders, all crankshaft bearing caps must be in place and tightened to proper

torque to avoid distortion of bores in final assembly. Always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. When taking the final cut with boring bar leave .001" on the diameter for finish honing to give the required clearance specified below.

When honing cylinders use clean sharp stones of proper grade for the amount of metal to be removed, in accordance with instructions of the hone manufacturer. Dull or dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones use care to leave sufficient metal so that all stone marks may be removed with the fine stones used for finishing to provide proper clearance.

When finish honing, pass the hone through the entire length of cylinder at the rate of approximately 60 cycles per minute. This should produce the desired 45 degree cross hatch pattern on cylinder walls which will insure maximum ring life and minimum oil consumption.

It is of the greatest importance that refinished cylinder bores are trued up to have not over .0005" out-of-round or taper. Each bore must be final honed to remove all stone or cutter marks and provide a smooth surface. During final honing, each piston must be fitted individually to the bore in which it will be installed and should be marked to insure correct installation.

After final honing and before the piston is checked for fit, each cylinder bore must be thoroughly washed to remove all traces of abrasive and then dried thoroughly. The dry bore should then be brushed clean with a power-driven fibre brush. If all traces of abrasive are not removed, rapid wear of new pistons and rings will result.

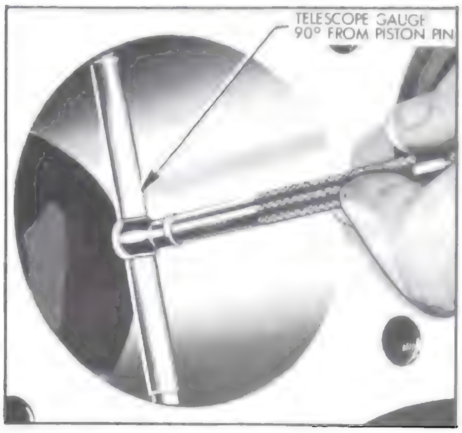


Figure 2-43—Using Telescope Gauge in Cylinder Bore

Pistons must be fitted with the use of accurate micrometers capable of reading to one ten thousandths of an inch.

A satisfactory method of fitting pistons is as follows:

1. Expand a telescope gauge t fit the cylinder bore at righ angles to the piston pin and between 1-1/2" and 2" from the top of the bore. See Figure 2-43.

2. Measure the telescope gauge. See Figure 2-44.

3. Measure the piston to be installed. See Figure 2-42. The piston must be measured at right angles to the piston pin below the oil ring groove.

4. The tolerance of piston clearance is .001" to .0016".

Both block and piston must be at very nearly the same temperature when measurements are taken or errors due to expansion will occur. A difference of 10°F between parts is sufficient to produce a variation of .0005".

e. Fitting New Piston Rings

When new piston rings are installed without reboring cylinders, the glazed cylinder walls should be slightly dulled, but without increasing the bore diameter, by means of the finest grade of stones in a cylinder hone.

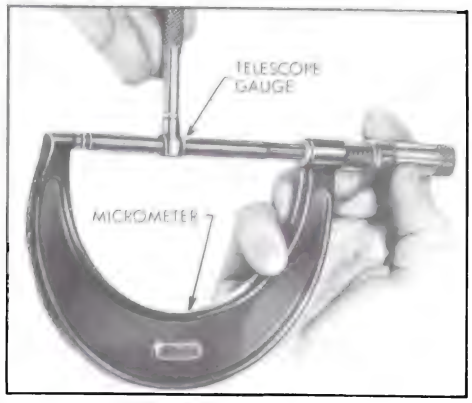


Figure 2-44—Measuring Telescope Gauge

New piston rings must be checked for clearance in piston grooves and for gap in cylinder bores; however, the flexible oil rings are not checked for gap. The cylinder bores and piston grooves must be clean, dry and free of carbon and burrs.

With rings installed, check clearance in grooves by inserting feeler gauges between each ring and its lower land because any wear that occurs forms a step at inner portion of the lower land. If the piston grooves have worn to the extent that relatively high steps exist on the lower lands, the piston should be replaced because the steps will interfere with the operation of new rings and the ring clearances will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

When fitting new rings to new pistons the side clearance of the compression rings should be .003" to .005" and side clearance of the oil ring should be .0035" to .0095".

To check the gap of compression rings, place the ring in the cylinder in which it will be used, square it in the bore by tapping with the lower end of a piston, then measure the gap with feeler gauges. Piston rings should not have less than .015" gap when placed in cylinder bores. If gap

is less than .015", file the ends of rings carefully with a smooth file to obtain proper gap.

f. Assembly and Installation of Piston and Connecting Rod Assemblies

NOTE: Connecting rods may be sprung out of alignment in shipping or handling; therefore, they must be checked before pistons and pins are installed.

Check bend and twist on an accurate rod aligning fixture using Guide Pin J-6047-16 (from wrist pin press) in place of wrist pin. Press V-block firmly and evenly against guide pin to prevent cocking pin in eye of rod which may be up to .002" larger diameter than pin.

1. To assemble piston, pin, and rod, first place Piston Pin Spacer J-6047-21 and Piston Support J-6047-18 in base plate of press. Use the piston support with the full radial face upward.

2. Place rod in piston, with oil spurt notch on same side as valve depressions in piston dome, lubricate piston pin and inside diameter of pin holes with Lubriplate. Insert pin into piston boss, pushing pin through to move rod over against opposite pin boss.

3. Place small end of Drive Pin J-6047-4 in hole in upper (protruding) end of piston pin and position the assembly in the press.

4. Make certain that all units are in alignment, then apply pressure and force pin through rod until Guide Pin J-6047-18 stops downward travel.

5. Release pressure and remove piston and rod assembly from press. Rotate piston on pin to check on fit between piston and pin.

6. Install oil ring expander in third groove of each piston, placing ends in area above either end of piston pin where groove is not slotted. Install oil ring over expander with gap on same side as valve depressions in piston head.

NOTE: To make certain expander ring does not overlap on 425 cu. in. engines a red and blue mark will be visible on ring. See Figure 2-45A.

NOTE: The rails and spacer of the oil ring are lightly held together with an oil soluble cement. If parts have separated they may be installed as individual pieces.

7. Install compression rings in first and second lands of each piston. Top rings are assembled with inner bevel toward top of piston and second ring inner bevel toward bottom of piston. See Figure 2-45.

All compression rings are marked either with a dimple, a letter "T", a letter "O", to identify the side of the ring which must be assembled "UP".

NOTE: On 425 cu. in. engines install chrome compression in top land of piston. Install plain ring backed up with an expander in the second land of piston.

8. Make sure that cylinder bores, pistons, connecting rod bearings and crankshaft journals are absolutely clean, then coat all bearing surfaces with engine oil.

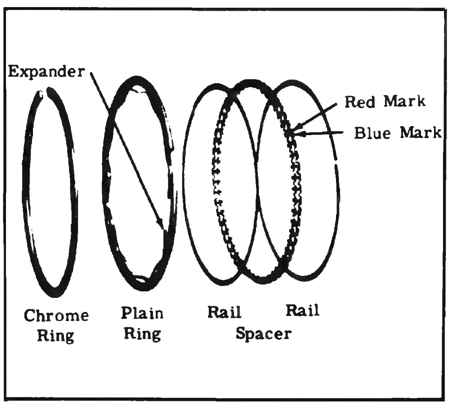


Figure 2-45A—425 Cu. In. Engine Piston Rings

9. Before installation of a piston and rod assembly in its cylinder bore, turn crankshaft to place the crankpin straight down.

10. Remove cap, and with bearing upper shell seated in connecting rod, install the long Guide J-5239-2 on bolt which is on same side of rod as the oil spurt notch in the bearing parting surface. Install short Guide J-5239-1 on the other connecting rod bolt.

These guides hold the upper bearing shell in place and protect the crankpin journal from damage during installation of connecting rod and piston assembly.

11. Make sure that gap in oil rails are on same side as valve depressions in piston head so that gap will be on high side of cylinder bore, turn compression rings so that gaps are not in line, then compress all rings with wrap-around type ring compressor.

12. Insert piston and rod assembly into its cylinder bore with the long guide pin placed above the crankpin. Push the assembly down until the rod bearing seats on crankpin. See Figure 2-41.

13. Select new connecting rod bearing, if necessary, as described in paragraph 2-18. Otherwise, install cap with bearing lower shell on rod and tighten bolt nuts to 40-45 ft. lbs. torque.

14. Install all other piston and rod assemblies in the same manner.

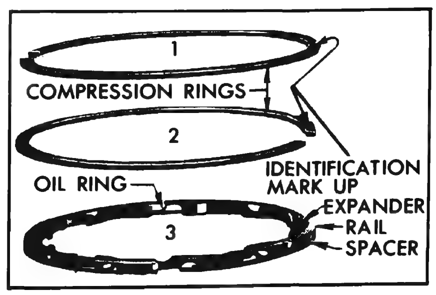


Figure 2-45—Compression and Oil Rings

When parts are properly installed, the valve clearance depressions in all piston heads and the oil spurt notches in all connecting rods will be toward the camshaft. The rib on edge of rod cap will be on same side as the conical boss on web of rod, and these marks will be toward the other connecting rod on the same crankpin.

15. Check end clearance between connecting rods on each crankpin using feeler gauges. Clearance should be .005"-.012".

16. Install cylinder heads (par. 2-15, d) oil pump (par. 2-25) and oil pan.

IMPORTANT: After installation of new pistons and rings, care should be used in starting the engine and in running it for the first hour. Avoid high speeds until the parts have had a reasonable amount of break-in so that scuffing will not occur.

SECTION 2-F
COOLING AND OILING SYSTEMS SERVICE

CONTENTS OF SECTION 2-F

2-20 COOLING SYSTEM SERVICES

a. Checking and Filling Cooling System

The coolant level should be checked only when the engine is cold and only enough coolant should be added to bring the level halfway between core and tank top.

It is unnecessary and undesirable to remove the radiator cap and check the coolant level each time the car stops at a filling station for gasoline or oil, since the engine is usually hot at such times.

CAUTION: Never remove the radiator cap quickly when engine is HOT. Sudden release of cooling system pressure may cause the coolant to boil and some of it may be ejected from the radiator filler neck, resulting in injury to persons or damage to the car finish.

If it is necessary at any time to remove the radiator cap when engine is hot, rotate the cap counterclockwise until a stop is reached. Leave cap in this position until all pressure in cooling system has been released, then turn cap forcibly past the stop and remove it.

b. Draining, Flushing, Conditioning Cooling System

The cooling system should be completely drained and the recommended coolant installed every two (2) years.

To drain the cooling system, remove radiator cap, open the drain cock in the lower radiator tank and remove drain plugs on both sides of cylinder block. If car is heater equipped, set heater temperature control valve at full heat position.

After the cooling system is drained, plugs reinstalled and cock closed, fill the system with clean water. Run the engine long enough to open the thermostat for complete circulation through the system, then completely drain the cooling system before sediment has a chance to settle.

c. Conditioning the Cooling System

"Rust Inhibitor and Stop Leak", listed under Group 8.800 is recommended for use in the cooling system, particularly when preparing for installation of anti-freeze solution. This material stops small seepage leaks, has rust preventive properties and its soluble oil is effective in eliminating a squealing noise which sometimes develops at the water pump seal washer. Instructions for its application are printed on the conditioner bottle.

It is very important to make certain that the cooling system is properly prepared before an anti-freeze solution is installed; otherwise, loss of solution through leakage may occur or seepage may result in damage to the engine. The cooling system should be drained and flushed as described above (subpar. b.), all joints should be checked for leakage and corrected, and the conditioner described above should be added with the anti-freeze solution.

Inspect the water pump, radiator core, heater and defroster cores, drain cocks, water jacket plugs, and edge of cylinder head gaskets for evidence of water leaks. Tighten all hose clamps in the cooling and heating systems and replace any deteriorated hoses.

d. Using and Testing Anti-Freeze Solutions

Inhibited year around (permanent type) engine coolant solution which is formulated to withstand two full calendar years of normal operation without draining or adding inhibitors should be used at all times. Freeze protection should be provided to protect against corrosion. When adding solution due to loss of coolant for any reason or in areas where temperatures lower than -20°F. may be encountered, a sufficient amount of any of the several brands of year around coolant (Ethylene Glycol base) compatible to GM Specification 1899-M available on the market should be used.

NOTE: Alcohol base coolants are not recommended for this vehicle at any time.

If for any reason water only is used as a coolant in an emergency, it is extremely important that Buick Heavy Duty Cooling System Protector and Water Pump Lubricant be added to the cooling system as soon as possible. This material is available at your Buick dealer under Part #980504. If any other cooling system protector is used, be certain it is labeled to indicate that it meets General Motors Specification GM 1894-M. It should be recognized that this is only a temporary measure. The manufacturer intends that permanent type coolant solution be used year around in the cooling system of your Buick.

The cooling system should be completely drained and the recommended coolant installed every two (2) years.

It is advisable to test the anti-freeze solution at intervals during the winter to make certain that the solution has not been weakened by evaporation or leakage. Use only hydrometers which are calibrated to read both the specific gravity and the temperature, and have a table or other means of converting the freezing point at various temperatures of the solution. Disregarding the temperature of the solution when making the test may cause an error as large as 30°F. Care must be exercised to use the correct float or table for the particular type of anti-freeze being tested.

2-21 FAN BELT ADJUSTMENT OR REPLACEMENT

A tight fan belt will cause rapid wear of the generator and water

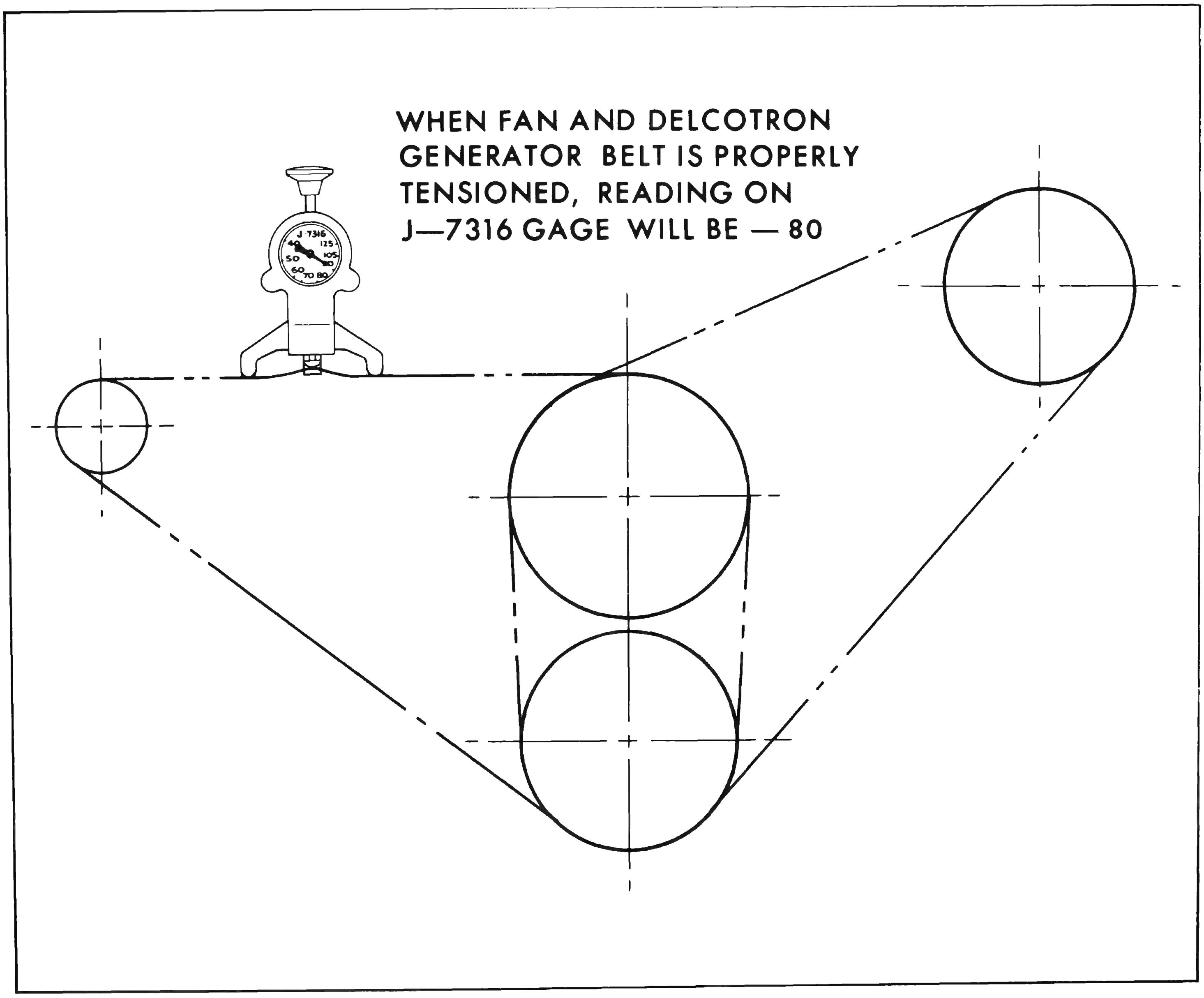


Figure 2-46—Belt Tension Chart (401 & 425 Cu. In. Engines)

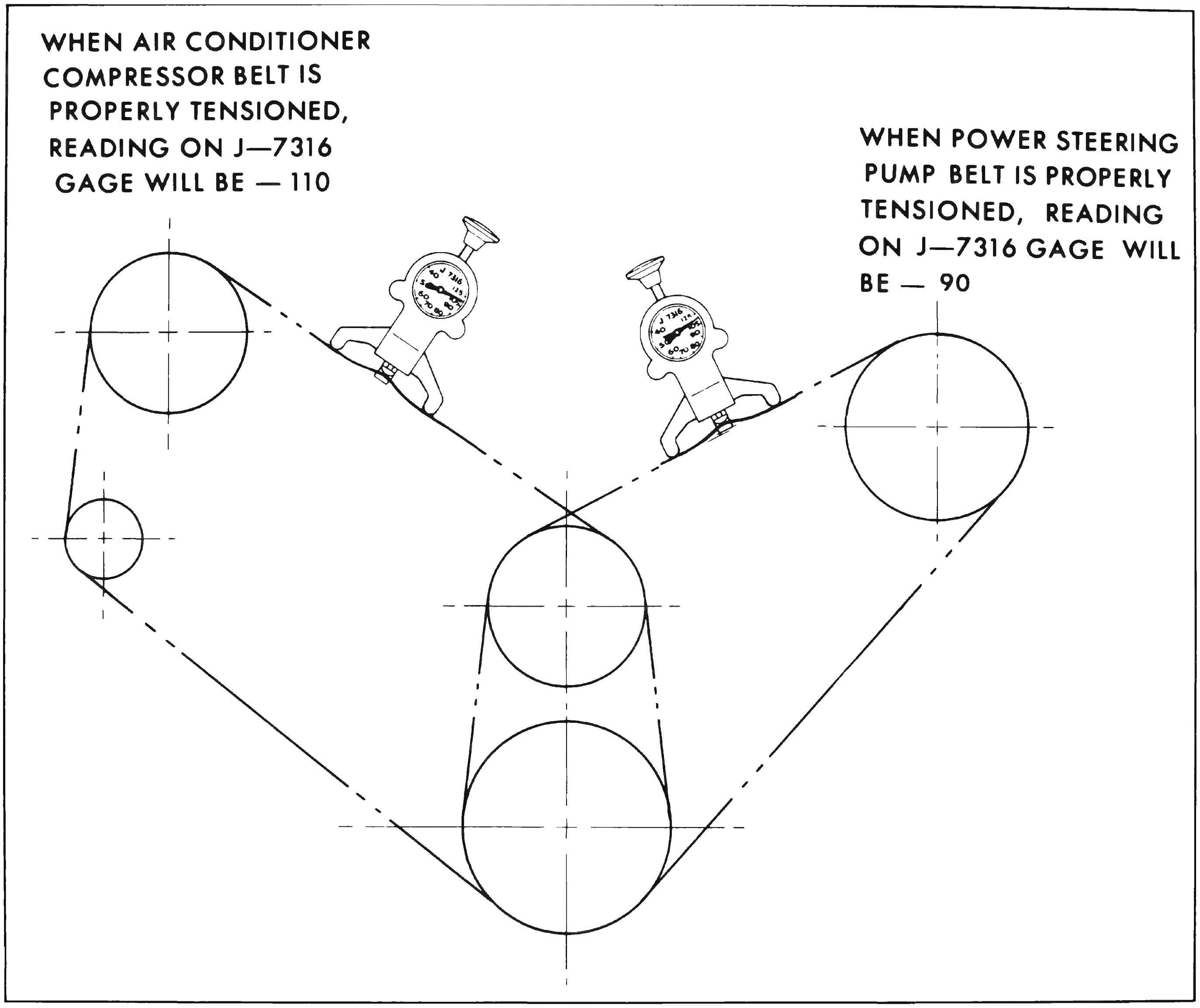


Figure 2-47—Belt Tension Chart - Air Conditioned Jobs (401 and 425 Cu. In. Engine)

pump bearings. A loose belt will slip and wear excessively and will cause noise, engine overheating, and unsteady generator output. A fan belt which is cracked or frayed, or which is worn so that it bottoms in the pulleys should be replaced.

The fan belt may be replaced by loosening the generator brace at both ends, slightly loosening the generator mounting bolts and moving generator inward to provide maximum slack in the belt. On a car equipped with power steering, it is also necessary to remove the oil pump drive belt after loosening the pump mounting bolts.

The Delcotron generator must be moved sidewise to adjust the fan belt. After the Delcotron generator brace and mounting bolts are securely tightened, the fan belt tension should be checked as shown in Figure 2-46 and 2-47 for 401 and 425 engines; Figure 2-47 and 2-48 for 300 cu. in. engine.

If the power steering oil pump belt is removed it should be adjusted as shown in Figures 2-46 2-47, 2-48 and 2-49.

If the Air Conditioner compressor belts are removed they should be adjusted as shown in Figures 2-48 and 2-49.

2-22 RADIATOR THERMOSTAT INSPECTION AND TEST

A sticking radiator thermostat will prevent the cooling system from functioning properly. If the thermostat sticks in the open position, the engine will warm up very slowly. If the thermostat

sticks in the closed position, overheating will result.

The thermostat may be removed for inspection and test by partially draining the cooling system and disconnecting the water outlet and hose from the water manifold, in which the thermostat is located.

If the thermostat valve does not fully close when cold, replace the thermostat. If the valve will fully close when cold, test the thermostat for correct opening temperature by immersing the unit and a thermometer in a container of water over a heater. While heating the water do not rest either the thermometer or thermostat on bottom of container as this will cause them to be at higher temperature than the water. Agitate the water to insure uniform temperature of water, thermostat and thermometer.

The standard thermostat (180°) valve should start to open at a temperature of 177°F. to 182°F., and should be fully open at a temperature not in excess of 202°F. If thermostat does not operate at specified temperatures it should be replaced as it cannot be adjusted.

2-23 WATER PUMP REPAIRS

The water pump cover is die cast aluminum into which the water pump bearings are shrunk fit. For this reason the cover, shaft bearings and hub are not replaceable separately. The shaft seal and impeller are the only replaceable parts of the water pump.

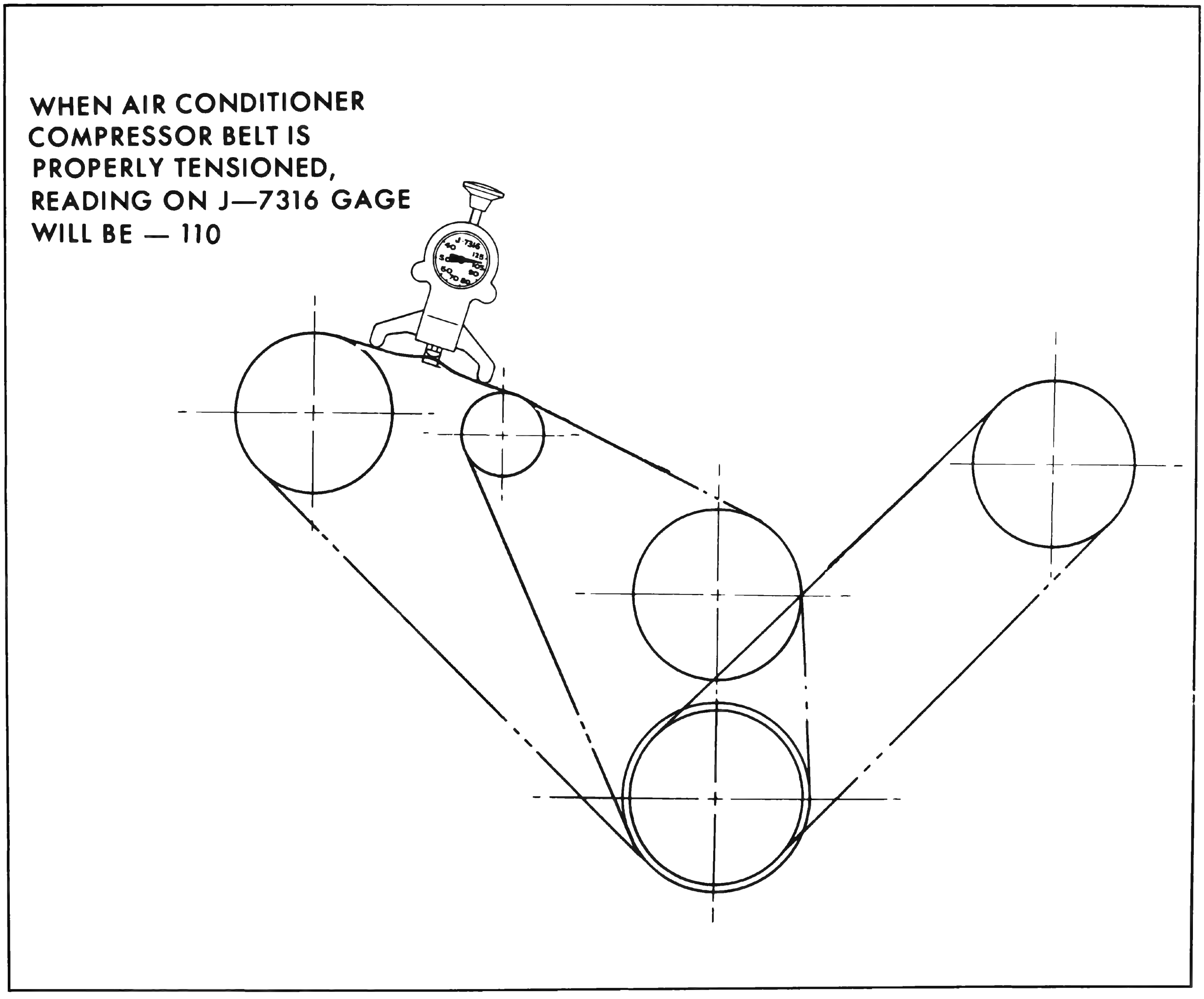


Figure 2-48—Belt Tension Chart Air Conditioned Jobs (225 & 300 Cu. In. Engines)

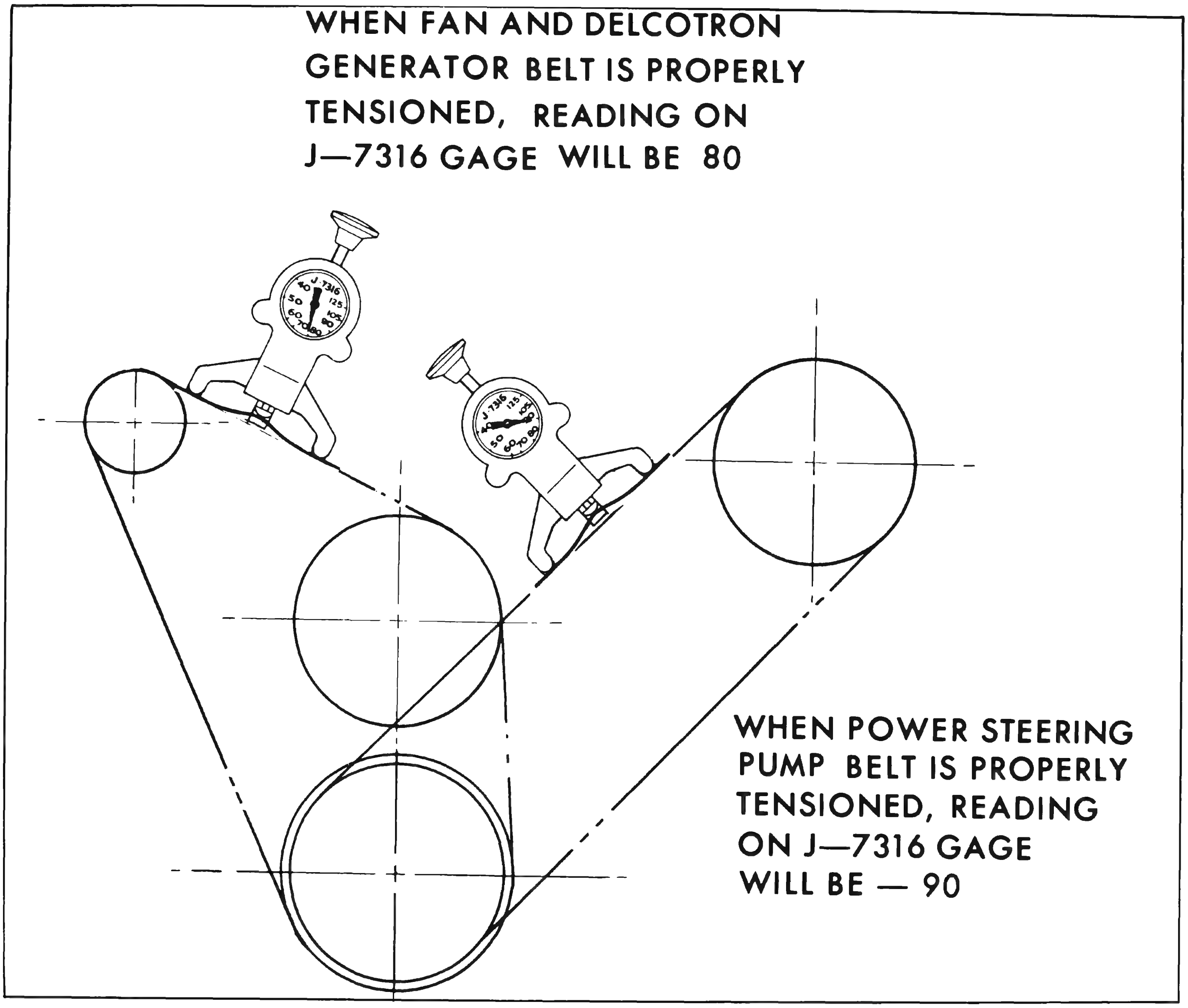


Figure 2-49—Belt Tension Chart—Non Air Conditioned Jobs (225 & 300 Cu. In. Engines)

a. Removal

1. Drain cooling system being sure to drain into a clean container if anti-freeze solution is to be saved.

2. Loosen belt or belts, then remove fan blade, spacer and pulley or pulleys from hub on water pump shaft. Remove belt or belts.

3. Disconnect hose from water pump inlet and heater hose from nipple. Remove bolts then remove pump assembly and gasket from timing chain cover.

4. Check pump shaft bearings for end play or roughness in operation. If bearings are not in serviceable condition, the assembly must be replaced.

b. Dissassembly for Seal Replacement

1. Support impeller and shaft on anvil or in vise to avoid any shock or thrust load on bearing when impeller is cracked. Crack impeller in two or three places with chisel. See Figure 2-49A.

2. Remove impeller. Insert a punch through vent hole in pump body and drive out old seal and sleeve.

3. Clean pump cover to remove scale, old gasket, etc. Do not use cleaning solvent as solvent may leak into bearings and destroy the lubricant.

4. Carefully press new seal assembly into cover using thick walled tube of suitable diameter.

NOTE: When installing new impeller extreme caution should be exercised so porcelain seal is not damaged.

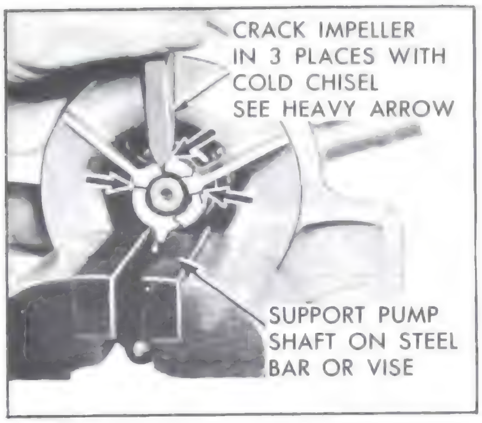


Figure 2-49A—Cracking Water Pump Impeller

5. Coat face of carbon washer and impeller hub with rust preventive or Seco oil. Press new impeller on shaft until .035" to .040" clearance exists between impeller and pump cover.

CAUTION: Avoid any pressing techniques that are likely to impose thrust loads on water pump bearings. Pump must be supported on forward end of shaft only while pressing on impeller. See Figure 2-17.

c. Installation

1. Make sure the gasket surfaces on pump and timing chain covers are clean. Install pump assembly with new gasket. Bolts with lock washers must be tightened uniformly.

2. Connect radiator hose to pump inlet and heater hose to nipple, then fill cooling system and check for leaks at pump and hose joints.

3. Install fan pulley or pulleys, spacer and fan blade, tighten attaching bolts securely. Install belt or belts and adjust for proper tension. See Figures 2-48 and 2-49.

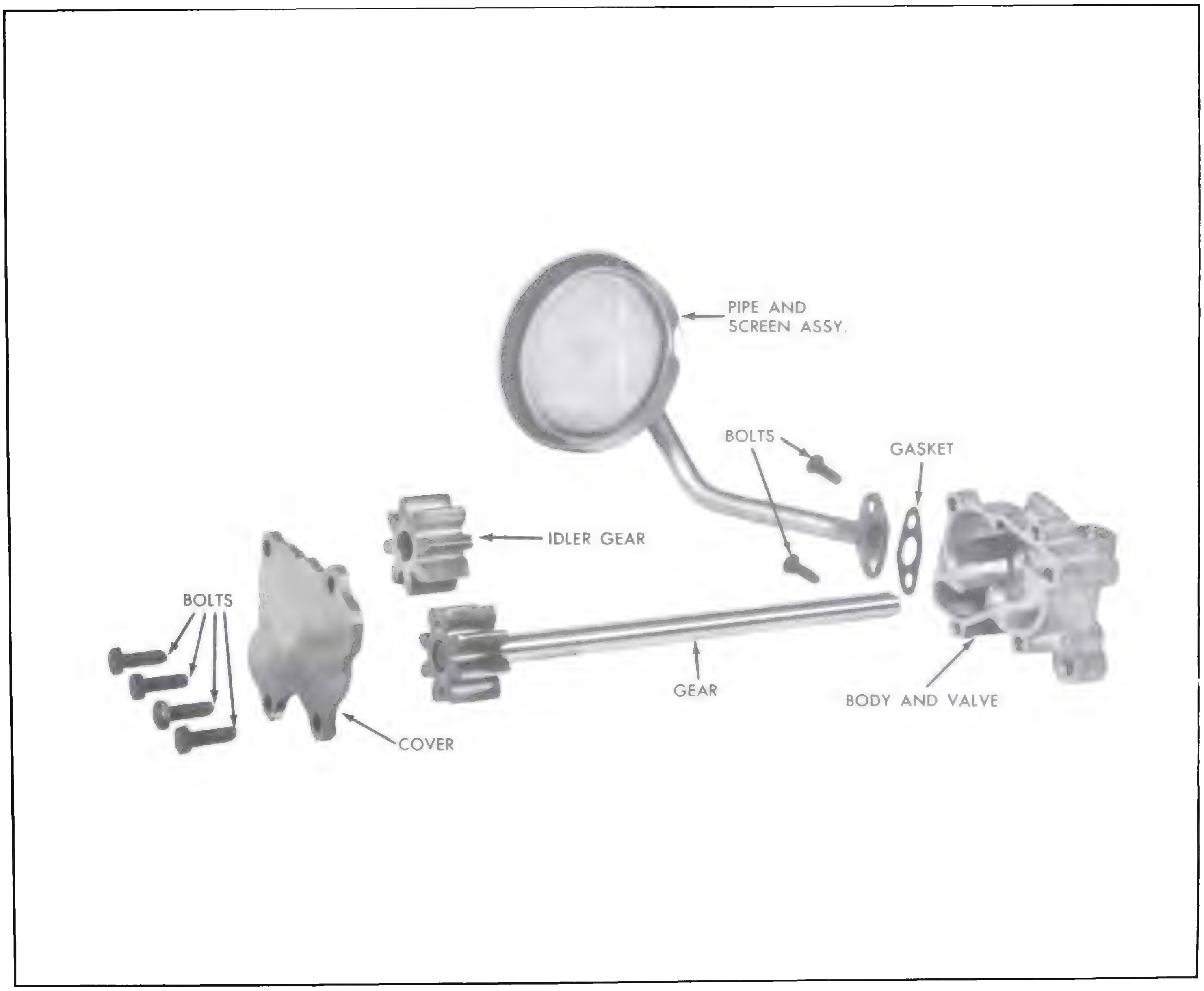


Figure 2-50—Oil Pump Exploded View

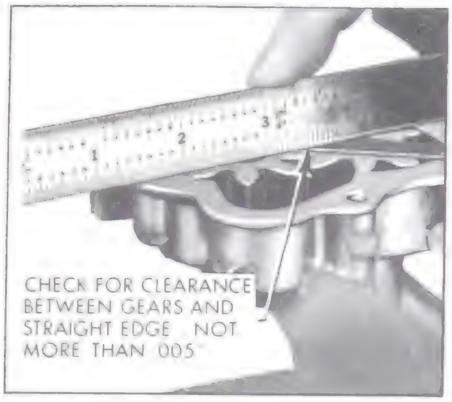


Figure 2-51—Checking Clearance of Gears at Cover

2-24 OIL PUMP REPAIRS (401 AND 425 CU. IN. ENGINES)

When an oil pump is removed for repairs the following procedure must be used to inspect parts and assemble pump in order to insure adequate oil pressure when the work is completed.

1. Remove Pipe and screen assembly.

2. Remove cover. Slide gears out of body.

3. Wash all parts in solvent and blow dry with air hose.

4. Inspect body, cover gears and shaft for evidence of wear, scoring, etc. Replace any parts not found serviceable.

5. Install gear and shaft and idler gear in pump body.

6. Check for clearance between gears and cover by using a straight edge as shown in Figure 2-51.

7. Clearance should be not more than .005" or less than .0005".

8. Pack cavity and space between gears and body with petroleum jelly. Do not use chassis lube.

9. Install pump cover (side with groove toward gears).

10. Tighten bolts to 6-8 ft. lbs. torque.

11. Use new gasket and install pipe and screen to body. Tighten bolts to 6-8 ft. lbs. torque.

12. Before installation of pump be sure surface of crankcase is free of dirt or burrs that might tilt the pump and cause a bind.

13. Install oil pump with new gasket. Tighten bolts a little at a time while turning pump shaft through gear lash. If pump shaft tends to bind when bolts are tightened, it may be freed up by rapping body with mallet. Pump shaft must be free of bind when bolts are tightened. Torque bolts to 30 ft. lbs.

2-25 OIL PUMP SERVICE (300 CU. IN. ENGINE)

a. Removal of Oil Pump Cover and Gears

1. Remove oil filter.

2. Disconnect wire from oil pressure indicator switch in filter by-pass valve cap.

3. Remove screws attaching oil pump cover assembly to timing chain cover. Remove cover assembly and slide out oil pump gears.

b. Inspection

1. Wash off gears and inspect for wear, scoring, etc. Replace any gears not found serviceable.

2. Remove the oil pressure relief valve cap, spring and valve. See

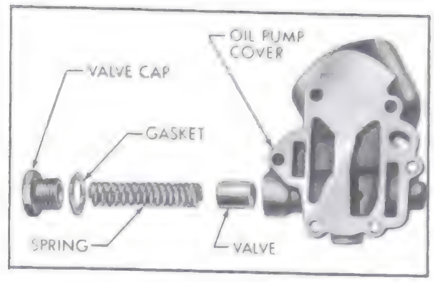


Figure 2-52—Oil Pump Cover Exploded View

Figure 2-52. Remove the oil filter by-pass valve cap, spring, and valve.

3. Wash the parts thoroughly and inspect the relief valve for wear or scoring. Check the relief valve spring to see that it is not worn on its side or collapsed. Replace any relief valve spring that is questionable. Thoroughly clean the screen staked in the cover.

4. Check the relief valve in its bore in the cover. The valve should have no more clearance than an easy slip fit. If any perceptible side shake can be felt the valve and/or the cover should be replaced.

5. Check filter by-pass valve for cracks, nicks, or warping.. The valve should be flat and free of nicks or scratches.

c. Assembly and Installation

1. Lubricate and install pressure relief valve and spring in bore of oil pump cover. See Figure 2-52. Install cap and gasket.

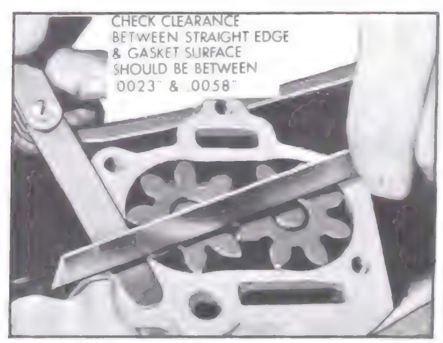


Figure 2-53—Checking Oil Pump Gear End Clearance

Torque cap to 30-35 pounds with a reliable torque wrench. Do not over-tighten.

NOTE: Pressure relief valve cap has no hole tapped for installation of oil pressure switch.

2. Install filter by-pass valve flat in its seat in cover. Install spring, cap and gasket. Torque cap to 30-35 ft. lbs. using a reliable torque wrench.

3. Install oil pump gears and shaft in oil pump body section of timing chain cover to check gear end clearance.

4. Place a straight edge over the gears and measure the clearance between the straight edge and the gasket surface. Clearance should be between .0023" and .0058". If clearance is less than .0018" check timing chain cover gear pocket for evidence of wear.

5. If gear end clearance is satisfactory, remove gears and pack gear pocket full of petroleum jelly. Do not use chassis lube!!!

6. Reinstall gears so petroleum jelly is forced into every cavity of the gear pocket and between the teeth of the gears. Place new gasket in position.

NOTE: This step is very important. Unless the pump is packed with petroleum jelly, it may not prime itself when the engine is started.

7. Install cover assembly screws. Tighten alternately and evenly. The torque specification is 10-15 ft. lbs.

8. Install filter on nipple.

SECTION 2-G
ENGINE MOUNTING ADJUSTMENT, FLYWHEEL REPLACEMENT, ENGINE BALANCING

CONTENTS OF SECTION 2-G

2-26 ENGINE MOUNTING ADJUSTMENT

The engine and transmission when properly aligned with the frame will rest in a normal position which does not impose any shear strain on the rubber mounting pads.

Shims are installed in production to locate the transmission support between the frame rails with respect to the front engine mounts. For this reason it is important that the position of the support not be changed by the removal of shims to move it side ways. Whenever it is necessary to remove the support, the number and location of the shims at each end of the support should be noted so they may be reinstalled in the same location.

The following procedure should be used when tightening mounts to obtain proper adjustment:

1. Loosen exhaust pipe or pipes at exhaust manifolds.

2. Loosen four engine mount to frame bolts.

3. Make sure that transmission support to frame shims are in original position and tighten all support to frame rail, support to mount, and mount to rear bearing retainer bolts. See Figure 2-44.

4. Raise engine slightly to allow mounts to normalize. Lower engine and tighten engine mount to frame bolts.

2-27 FLYWHEEL REPLACEMENT

a. Replace Flywheel and Check Run-out

1. Remove the transmission then remove the flywheel from the crankshaft flange.

2. Inspect flywheel. If flywheel is cracked at crankshaft bolt holes, replace flywheel.

3. Check for burrs around drilled holes in crankshaft flange and face of flywheel to be installed; remove any burrs with a mill file. Position flywheel so 3/8" locating hole in flywheel bolt hole circle is matched with locating hole in crankshaft. Install bolts and tighten evenly to 50-60 ft. lbs. torque.

4. Mount Dial Indicator so that stem of indicator bears against the flat surface of flywheel.

5. Turn flywheel, making sure that crankshaft end thrust is held in one direction, and note run-out of flywheel face. Run-out should not exceed .015".

6. If run-out exceeds .015" attempt to correct by tapping high side of flywheel with mallet. If this does not correct run-out remove flywheel and check for burrs between flywheel and face of crankshaft flange. Remove burrs and recheck for run-out.

7. If no burrs exist install a new flywheel and recheck run-out. If run-out still exceeds .015" check run-out of rear face of crankshaft flange.

8. After installation of transmission, test for engine vibration. If vibration has been introduced by installation of new flywheel make correction as described in paragraph 2-27.

GROUP 3

ENGINE FUEL AND EXHAUST SYSTEMS

SECTIONS IN GROUP 3

SECTION 3-A

SPECIFICATIONS AND GENERAL DESCRIPTION

CONTENTS OF SECTION 3-A

3-1 SPECIFICATIONS, FUEL AND EXHAUST SYSTEMS

a. General Specifications

Gasoline, Grade Required (with LeSabre 2-Barrel Carburetor Engine)	Regular
Gasoline, Grade Required (Other Engines)	Premium
Gasoline Tank Capacity (Gal.)	20
Gasoline Gauge, Make and Type	A.C., Electric
Fuel Pump—Make and Type	A.C., Mechanical
Drive	Eccentric at Camshaft Sprocket
Fuel Pump Pressure - At Carburetor Level, Pounds	
300 Engine	4 to 5 1/4
401-425 Engines	4 3/4 to 6 1/2
Fuel Filter, in Gas Line	A.C., Can-Type Throw-Away
Type, Standard	GF-94
Type, Air Conditioned	GF-96
Fuel Filter, In Gas Tank	Woven Plastic
Carburetor, Make	Carter or Rochester
Type	Downdraft
Barrels	2, 4 or Dual 4
Air Cleaner, Make and Type (Standard)	A.C., Plastic Foam Element
Air Cleaner, Make and Type (Riviera or Dual 4-Barrel)	A.C., Paper Element
Intake Manifold Heat - Type (300 Engine)	Hot Water Passage in Manifold
Intake Manifold Heat--Type (401-425 Engines)	Hot Exhaust Passage in Manifold
Thermostat Wind-Up @70 Degrees F., Valve Closed	1/2 Turn
Idle Speed	300 Cu. In. 550 RPM, All Others 500 RPM (Add 50 RPM if Air Cond.)
Air Conditioned Car (Air Conditioner Off)	Add 50 RPM

b. Carter Carburetor Calibrations

IMPORTANT: Calibrations are governed by the CODE number.

	401 Eng. Auto. Trans.	425 Eng. Auto. Trans.	401-425 Eng. Syn. Trans.	Dual 4-Bbl. All Front	Dual 4-Bbl. Rear-Auto.	Dual 4-Bbl. Rear-Syn.
Model Designation	AFB	AFB	AFB	AFB	AFB	AFB
Number of Barrels	4	4	4	4	4	4
Code Number, for Following Calibrations	3633S	3665S	3635S	3645S	3646S	3634S
Bore Diameter, Primary	1 9/16"	1 9/16"	1 9/16"	1 9/16"	1 9/16"	1 9/16"
Large Venturi Diameter, Primary	1 3/16"	1 3/16"	1 3/16"	1 3/16"	1 3/16"	1 3/16"
Bore Diameter, Secondary	1 11/16"	1 11/16"	1 11/16"	1 11/16"	1 11/16"	1 11/16"
Large Venturi Diameter, Secondary	1 9/16"	1 9/16"	1 9/16"	1 9/16"	1 9/16"	1 9/16"
Float Level Adjustment	7/32"	7/32"	7/32"	7/32"	9/32"	7/32"
Float Drop Adjustment	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
Float Needle Seat	#38	#38	#38	#38	#38	#38
Low Speed Jet	#65	#68	#68	#68	#68	#68
Idle Discharge Port	.200" x .030"	.185" x .030"	.185" x .030"	.150" x .030"	.150" x .030"	.180" x .030"
Lower Idle Port	#52	#52	#52	#69	#52	#52
Metering Jet, Primary	120-256	120-256	120-256	120-256	120-256	120-256
Metering Jet, Secondary						
Production	120-158	120-159	120-165	120-222	120-222	120-222
High Altitude	120-233	120-165	120-165	-	-	-
Metering Rod						
Production	16-219	16-167	16-219	16-268	16-219	16-298
High Altitude	16-255	16-256	16-255	-	-	-
NOTE: Use High Altitude Kit Above 3500 Feet						
Use Kit Consisting of Secondary Jets, Primary Rods and Springs.						
Throttle Bore Vents	#42	#42	#42	#42	#42	#42
Anti-Percolator or Main Bleed Hole	#64	#64	#64	#64	#64	#64
Pump Setting at Closed Throttle	7/16" Center Hole	7/16" Center Hole	7/16" Center Hole	1/2" Center Hole	1/2" Inner Hole	1/2" Inner Hole
Pump Discharge Jet	#70	#70	#70	#70	#70	#70
Vacuum Spark Control Hole	3/32"	3/32"	.130" x .040"	NONE	.130" x .040"	.130" x .040"
Choke Coil Housing Number	170AW478S	170AW478S	170AW478S	NONE	170AW478S	170AW478S
Choke Thermostat Setting	Index	Index	Index	Index	Index	Index
Choke Suction Hole	#40	#40	#40	#40	#40	#40
Choke Piston Setting (With .026" Wire)	.115"	.115"	.115"	.115"	.115"	.115"
Closing Shoe Clearance	.020"	.020"	.020"	.020"	.020"	.020"
F. I. Cam Setting, Choke Closed	Index	Index	Index	Index	Index	Index
F. I. Cam Number	181-292	181-292	181-292	NONE	181-292	181-284
Unloader Opening at Choke Valve Edge	7/32"	7/32"	7/32"	7/32"	7/32"	7/32"
Initial Idle Speed	1/2 Turn In	1/2 Turn In	1/2 Turn In	1/2 Turn In	1/2 Turn In	1/2 Turn In
Initial Idle Mixture	3/4 Turn Out	3/4 Turn Out	3/4 Turn Out	3/4 Turn Out	2 Turns Out	2 Turns Out
Fast Idle Speed in Drive (Hot, on Low Step)	600 RPM	600 RPM	600 RPM	NONE	600 RPM	600 RPM

c. Rochester Carburetor Calibrations

IMPORTANT: Calibrations are governed by the CODE number on the attached code tag.

ROCHESTER 2-BARREL

Items	300 Eng. Syn. Trans.	300 Eng. Auto. Trans.
Model Designation	2 GC	2 GC
Number of Barrels	2	2
Code Number, for Following Calibrations	7024047	7024046
Throttle Bore	1 7/16"	1 7/16"
Small Venturi	1/8"	1/8"
Large Venturi	1 1/8"	1 1/8"
Main Metering Jet		
Production	.054"-60°	.053"-60 Sq.
High Altitude	.052"-60°	.051"-60 Sq.

NOTE: Use high Altitude Jets Above 3500 Feet.

Items	300 Eng. Syn. Trans.	300 Eng. Auto. Trans.
Idle Tube Restriction	#69	#69
Idle Needle Hole	#56	#56
Spark Holes	2-#55	1 1/8"
Pump Discharge Holes	2-#71	2-#71
Choke Restriction		
Inlet	#43	#43
Outlet	1/8"	1/8"
Choke Setting	Index	2 Notches Rich
Choke Coil Number	39	15
Main Well Vent	#69	NONE
Dome Vent	#70	#67
Cluster Top Bleed	#64	#67
Cluster Side Bleed	#69	#68
Float Level Adjustment	1/2"	1/2"
Float Drop Adjustment	1 29/32"	1 29/32"
Pump Rod Adjustment (Outer Hole)	1 11/32"	1 11/32"
Choke Rod Adjustment	#60(.040")	#60(.040")
Fast Idle Cam Number	7026571	7017771
Choke Unloader Adjustment	#44(.085")	#44(.085")
Initial Idle Speed	3 Turns In	3 Turns In
Initial Idle Mixture	1 Turn Out	1 Turn Out

c. Rochester Carburetor Calibrations

IMPORTANT: Calibrations are governed by the CODE number on the attached code tag.

ROCHESTER 4-BARREL

Items	300 Eng. Syn. Trans.		300 Eng. Auto. Trans.		401 Eng. Auto. Trans.	
Model Designation	4GC		4GC		4GC	
Number of Barrels	4		4		4	
Code Number	7024045		7024044		7024040	
	Primary	Secondary	Primary	Secondary	Primary	Secondary
Throttle Bore	1 7/16"	1 7/16"	1 7/16"	1 7/16"	1 9/16"	1 11/16"
Small Venturi	1/8"	1/4"	1/8"	1/4"	1/4"	1/4"
Large Venturi	1 1/8"	1 1/4"	1 1/8"	1 1/4"	1 1/8"	1 15/32"
Main Metering Jets - Production	.054"-60°	.065"-60°	.053"-60°	.065"-60°	.052"-60°	.080"-60°
Main Metering Jets - High Altitude	.052"-60°	.063"-60°	.051"-60°	.063"-60°	.049"-60°	.077"-60°

NOTE: Use high Altitude Kit above 3500 feet. Kit consists of Primary Jets, Secondary Jets, and a Power Piston Assembly.

c. Rochester Carburetor Calibrations (Continued)

Items	300 Eng. Syn. Trans. 4GC 4		300 Eng. Auto. Trans. 4GC 4		401 Eng. Auto. Trans. 4GC 4	
Idle Tube Restriction	#70	#72	#67	#72	#68	#64
Idle Needle Hole	#55		#55		#55	
1st Idle Hole	#67		#68		#68	
2nd Idle Hole	#67		#66		#68	
3rd Idle Hole	#66		#66		#68	
4th Idle Hole	#66		#66		#67	
Spark Hole	2-#55		1 1/8"		1/8"	
Pump Discharge Hole	2-#71		2-#71		2-#71	
Choke Restriction - Inlet	#43		#43		3/16"	
Choke Restriction - Outlet	1/8"		1/8"		#41	
Choke Setting	Index		2 Notches Rich		Index	
Choke Coil Number	10		10		30	
Primary Float Level Adjustment (Heel)	1 21/64"		1 21/64"		1 11/32"	
~~Primary Float Level Adjustment (Toe)~~	~~19/32"~~		~~19/32"~~		~~17/32"~~	
~~Primary Float Drop Adjustment~~	~~1 19/32"~~		~~1 19/32"~~		~~1 7/16"~~	
~~Secondary Float Level Adjustment (Heel)~~	~~1 3/8"~~		~~1 3/8"~~		~~1 25/64"~~	
~~Secondary Float Level Adjustment (Toe)~~	~~3/8"~~		~~3/8"~~		~~13/32"~~	
~~Secondary Float Drop Adjustment~~	~~1 3/16"~~		~~1 3/16"~~		~~1 3/16"~~	
Pump Rod Adjustment	1-No. 1 Hole		7/8"-No. 3 Hole		1 1/64"-Center Hole	
Choke Rod Adjustment	#55(.050")		#55(.050")		#69(.030")	
Fast Idle Cam	7026749		7026748		7026857	
Choke Piston Setting, Choke Closed	Must Project 1/32"		Must Project 1/32"		Must Project 1/32"	
Choke Unloader Adjustment	#31(.120")		#31(.120")		#31(.120")	
Secondary Contour Adjustment	.030"		.030"		.030"	
Secondary Lockout Adjustment	.015"		.015"		.015"	
Initial Idle Speed	1 Turn In		1 Turn In		2 Turns In	
Initial Idle Mixture	1 1/2 Turns Out		1 1/2 Turns Out		1 1/2 Turns Out	
Fast Idle Speed in Drive (Hot, on Low Step)	600 RPM		600 RPM		600 RPM	

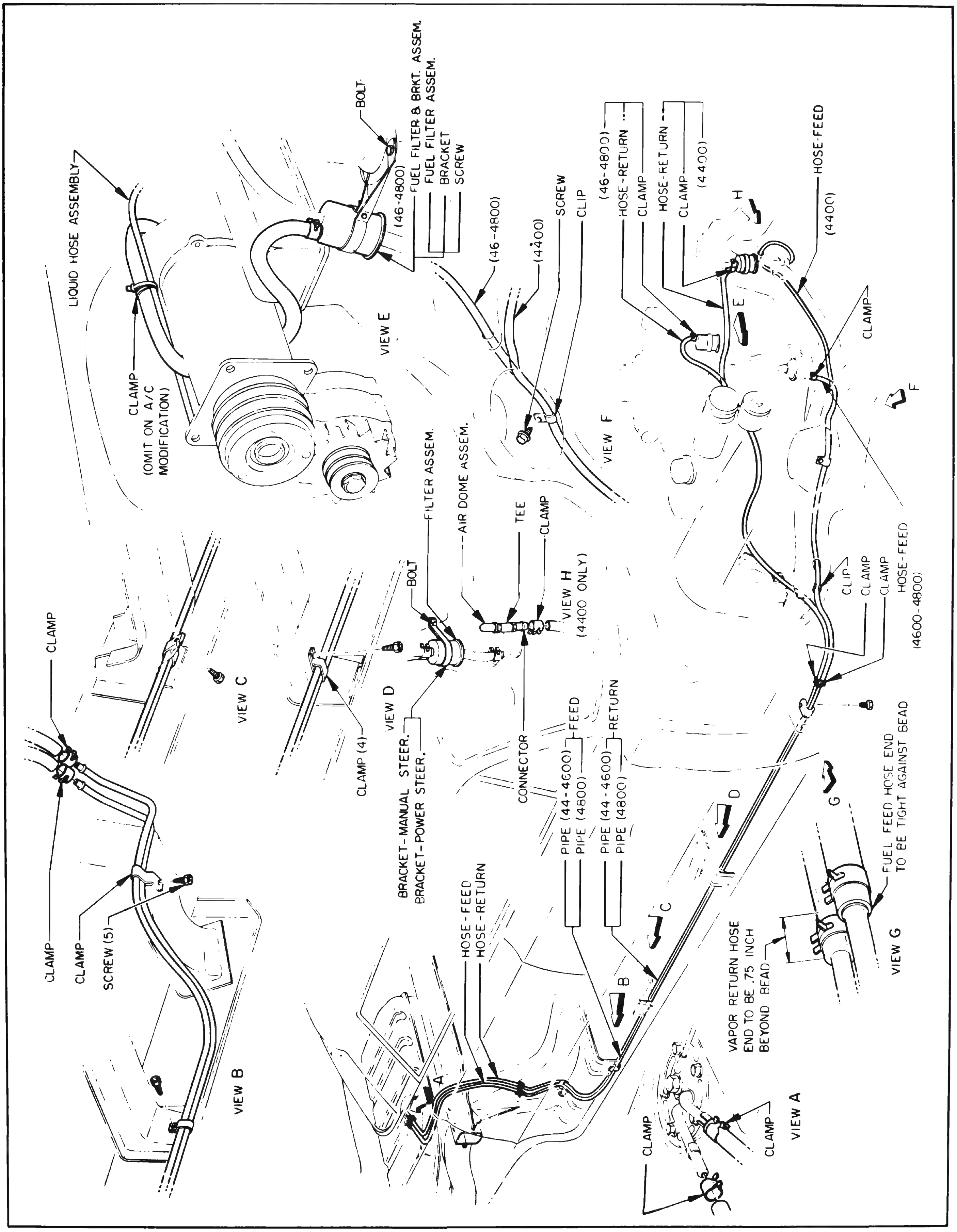


Figure 3-1—Fuel System-Air Conditioned Cars

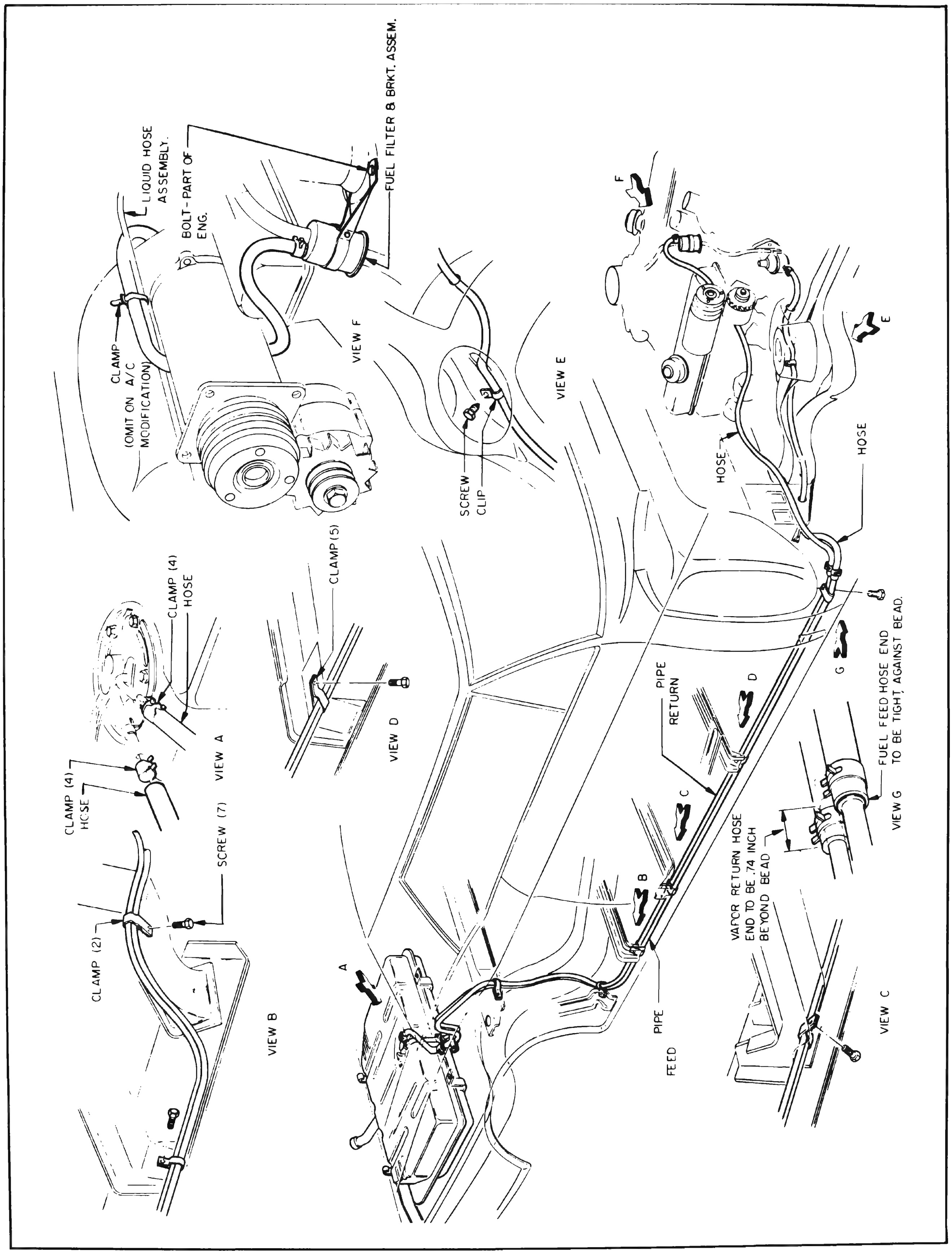


Figure 3-2—Fuel System–Air Conditioned Rivieras

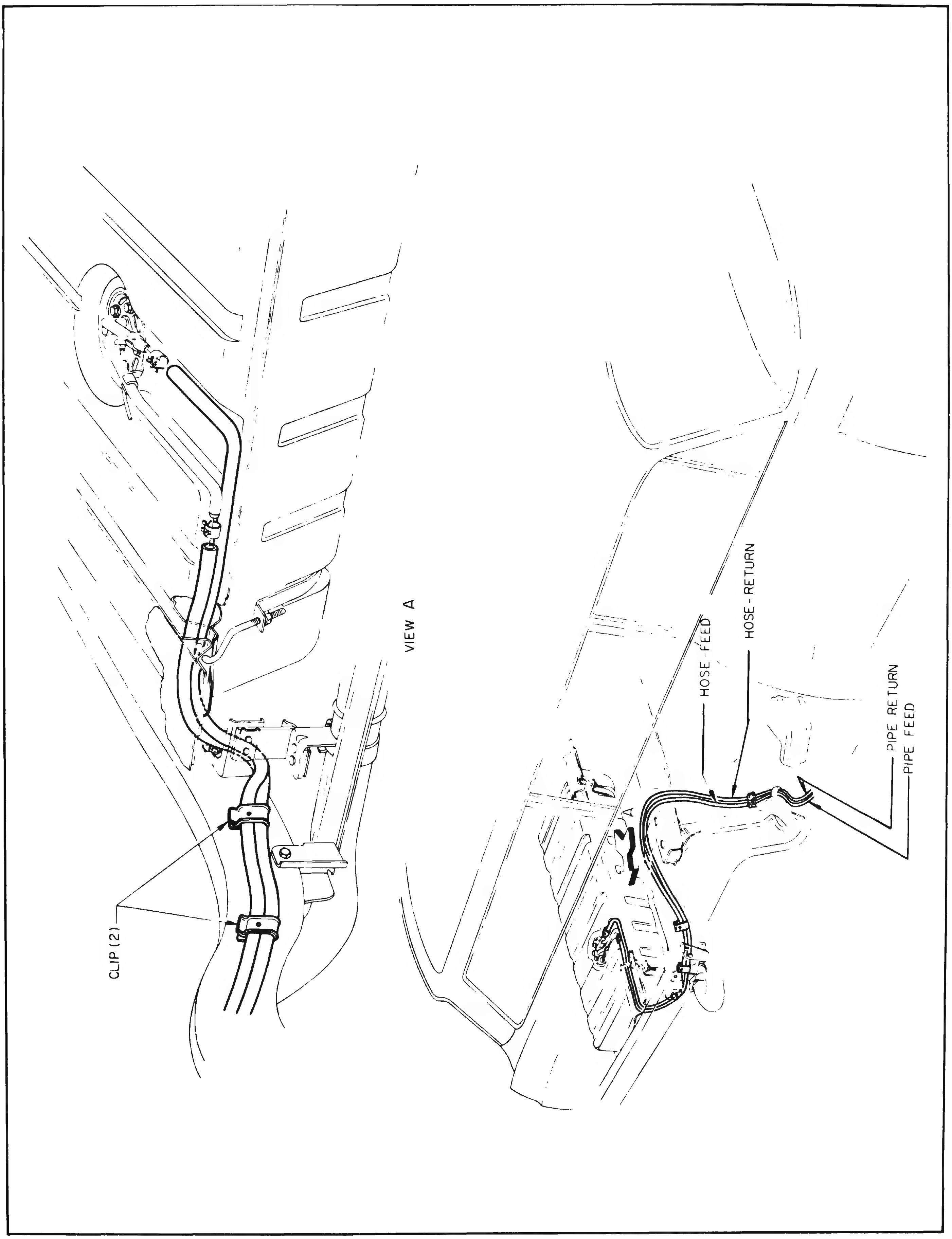


Figure 3-3—Fuel System-Air Conditioned Wagons

3-2 DESCRIPTION OF FUEL SYSTEM

a. Gasoline Tank, Feed Pipe and Filter

The gasoline tank is attached to the underbody in the kick-up area over the rear axle assembly (except Rivieras and estate wagons). The tank is attached directly by two bolts through the rear flange and two nuts at the front flange.

The lower section of the gas tank filler is soldered into an opening at the left upper center of the tank. A separate upper section of the tank filler is fastened to the body by four bolts. The upper and lower sections of the filler are joined with a short hose and two clamps. The tank is vented at a special pipe rather than at the filler cap. This breather pipe extends from the upper center of the tank and has a rubber hose extending from it to an inverted U-shaped pipe fastened into the body. A positive sealing filler cap is used.

The tank outlet is located at the top right center of the tank. It consists of a combination fuel pick-up, filter, and gas gauge tank unit. The tank unit can be removed without lowering the gas tank by removing a special access hole cover in the trunk compartment (all except Rivieras and estate wagons).

The fuel line is welded steel tubing with a terne coat outside and a tin coat inside. Connections from the tank to the line and from the line to the fuel pump are made with synthetic rubber hose attached with spring clamps.

A can-type throw-away fuel filter is located in the line between the fuel pump and the carburetor.

In all air conditioner equipped cars, a vapor by-pass system is installed. These cars have a special fuel filter which has a metering outlet in the top. Any vapor which forms is bled off and returned to the gas tank through a separate line alongside the fuel supply line. This system greatly reduces any possibility of vapor lock. See Figures 3-1 and 2.

b. Fuel Pump, Carburetor, and Automatic Choke

The fuel pump is mounted on the lower right side of the timing chain cover. It is actuated by a hardened, chrome-plated, stamped steel eccentric mounted on the front side of the crankshaft sprocket. The pump is inverted, thereby placing it in a lower, cooler location. It has a built in air dome with a diaphragm to dampen out pulsations in fuel pressure. The construction and operation of the pump are described in Section 3-D.

c. Air Cleaner and Intake Silencer

All engines (except Riviera and dual 4-barrel engines are equipped with oil wetted polyurethane foam element air cleaners combined with intake silencers. The air cleaner removes abrasive dust and dirt from the air before it enters the engine through the carburetor. The intake silencer reduces to a very low level the roaring noise made by the air as it is drawn through the intake system. The cleaner and silencer also functions as a flame arrester in event of "backfire" through the intake system.

There are four basic air cleaner and silencer assemblies: one for two barrel carburetor cars, one for four barrel carburetor cars, one for Rivieras, and one for dual four barrel carburetor cars. See Figure 3-4.

Standard four barrel carburetor air cleaners have two locating tabs which engage two projections on the carburetor air horn to locate the large air inlet tube firmly in position about 15° to the right of the center line of the engine.

Two barrel carburetor air cleaners have neither a support bracket nor locating tabs. Therefore it is important to securely tighten the wing nut by hand after locating the air cleaner on the carburetor to make sure the air cleaner remains stationary. Proper location is with the intake pointed about 45° to left of the center line of the engine and with the word

Figure 3-4—Air Cleaners and Silencer Assemblies

"FRONT" on the air cleaner forward. On power steering cars, the intake will be located about one inch to the rear of the power steering pump.

The air cleaner (except for Rivieras and dual 4-barrels) has a washable plastic foam type element. It consists of a cylinder of polyurethane foam over a perforated sheet metal supporting screen. This screen also acts as a flame arrester in case of a backfire. Riviera and dual 4-barrel air cleaners have a disposable dry type fiber element.

d. Carburetor Throttle Control Linkage

The carburetor throttle control linkage is designed to provide positive control of the throttle valves through their entire range without being affected by movement of the engine on its rubber mountings. See Figure 3-17.

The accelerator pedal is mounted on two ball studs. Depressing the accelerator pedal causes the pedal to make a rolling contact with a roller on the throttle operating lever, forcing the lower part of the lever to pivot forward and down. The lever pivots in a bearing mounted on the body cowl. See Figure 3-17.

As the lower part of the throttle operating lever is pushed forward by the accelerator pedal, the upper part of the lever is pulled rearward. This pulls the throttle rod rearward, causing the carburetor throttle lever to open the throttle valves.

The return spring returns the throttle linkage to idle position whenever pressure is released from the accelerator pedal. See Figure 3-14.

On automatic transmission cars, a dash pot is mounted in position to be contacted by an arm of the carburetor throttle lever as the throttle is closed. The dash pot cushions the closing of the throttle valves to prevent engine stalling when the accelerator pedal is suddenly released.

On all automatic transmission cars, a transmission detent switch is mounted at the full throttle position of the carburetor throttle lever. When the throttle linkage is moved to wide open throttle position, the switch contacts are closed to cause the transmission to "downshift". On 2-speed automatic transmission cars only, the switch also has a second set of contacts which close slightly before wide open throttle position to cause the stator blades in the transmission to "switch-the-pitch" to high performance angle. See Figure 3-17.

On 2-speed automatic transmission cars only, an idle stator switch is mounted at the closed throttle position of the carburetor throttle lever. Whenever the throttle linkage returns to curb idle position, the switch contacts are closed to cause the stator blades to "switch-the-pitch" to high angle. This reduces the transmission load on the engine at idle, thereby reducing the tendency of the car to creep. See Figure 3-17.

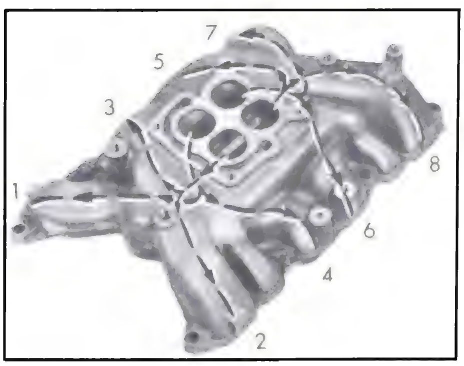


Figure 3-5—Intake Manifold Distribution—401 and 425 Engines

3-3 DESCRIPTION OF INTAKE AND EXHAUST SYSTEMS

a. Intake Manifold Distribution

A low-restriction, dual (2 section) intake manifold is bolted to the inner edges of both cylinder heads, where it connects with all inlet ports. The end branches of each section run at 90 degrees to the connecting middle branch, thereby forming a T-junction at the dividing point which assures a uniform division and distribution of fuel to all cylinder inlets. Each manifold section feeds four cylinders - two in each bank. See Figures 3-5, 6 and 7.

The 2-barrel carburetor feeds one barrel into each section of its 2 port manifold. The 4-barrel carburetor feeds one primary and one secondary barrel into each section of its 4 port manifold.

b. Intake Manifold Heat—401 and 425 Engines

The intake manifold is heated and hot spots are provided at the T-junction dividing points by cross-over chambers cast along the outer walls of each end branch. These chambers connect to the two middle exhaust passages in each cylinder head. Hot spots

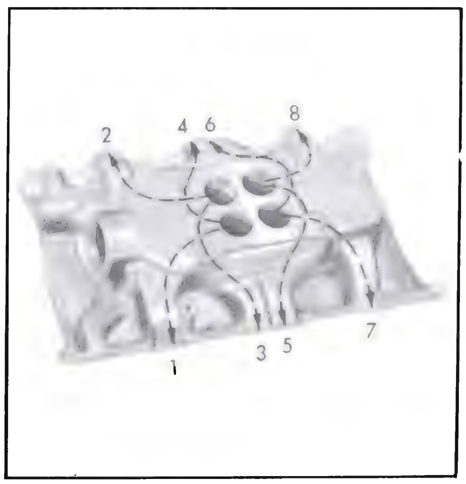


Figure 3-6—Intake Manifold Distribution—300 Engine

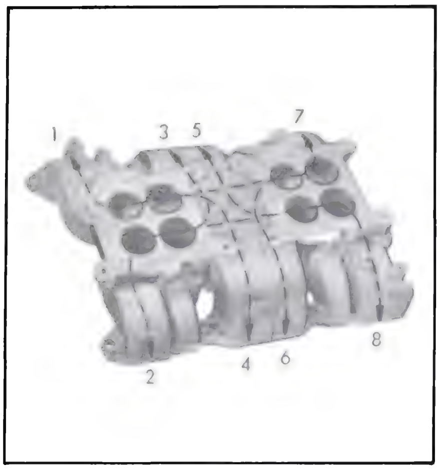


Figure 3-7—Intake Manifold Distribution-Dual 4-Barrel Engine

located at the dividing junctions aid in vaporizing the heavier particles of fuel which are swept against the outer walls due to their greater momentum. The heated intake manifold also aids in obtaining a uniform fuel distribution.

The intake manifold is heated by exhaust gas crossover passages cast under the center section of the manifold. These passages connect to the two middle exhaust passages in each cylinder head. Exhaust heat is supplied directly to the carburetor mounting surface by two holes drilled from the mounting surface into the crossover passages. The carburetors are designed to conduct this heat around the throttle valve area to reduce engine stalling due to carburetor icing.

A heat control valve with a bimetal thermostat is located below the right exhaust manifold. See Figures 3-14 and 15. When the engine is cold and the thermostat closes the valve, the resulting back pressure in the manifold forces exhaust gas through the crossover passages in the intake manifold to the left exhaust manifold. As the engine warms up and the thermostat releases the valve, the flow of hot gas through the crossover chamber is reduced. Restricted openings in the metal intake manifold gaskets meter the flow of exhaust gases through the intake manifold when the engine is cold and the heat valve is closed.

c. Intake Manifold Heat—300 Engine

The aluminum intake manifold is heated by engine coolant which flows from the front of each head into the two front corners of the intake manifold. The coolant flows through a jacket along the lower level of the intake manifold to the rear of the manifold, then forward along the upper level of the manifold to the engine thermostat. Due to the superior heat transfer characteristics of aluminum plus the fact that the jacket surrounds all branches of the intake manifold, the complete manifold is maintained at coolant temperature. No exhaust manifold valve or special exhaust passages are used.

During engine warm-up, the coolant temperature is not high enough to cause the engine thermostat to open. However, a thermostat by-pass allows a small amount of coolant to circulate continuously so that any heat available gets to the intake manifold. This heat helps prevent engine stalling due to carburetor icing.

d. Exhaust Manifolds, Pipes, and Mufflers

Each cylinder exhausts through an individual port into a separate branch of the exhaust manifold. This manifold, referred to as the double "Y" type, is designated to provide a separation of 270 degrees crankshaft rotation between any two exhaust impulses in one branch of the manifold. This elimination of overlap within any given branch of the manifold permits valve timing that improves engine efficiency, minimizes exhaust valve burning, and effects more complete scavanging of exhaust gas from the cylinder.

The right manifold contains the carburetor choke heat stove which consists of an alloy steel heating tube mounted in two drilled holes in the manifold. Heated air is drawn from the heat stove through an insulated pipe into the automatic choke housing.

All front and center exhaust pipe assemblies are made up of two layers (inner and outer) of welded pipe. Rear exhaust pipes and tail pipes use single layer pipe. The double layer pipe is used to muffle pipe "ring" which is set-up by the firing impulses of the individual cylinders; the life of the pipe is also greatly increased.

Most of the connections are of the ball joint type. These ball joints make for easy disconnection, connection, and alignment of the exhaust system without damage to the parts. No gaskets are used in the entire exhaust system. Connection of the tail pipe to the muffler is made with a U-bolt and clamp.

The muffler is of the oval-shaped, dynamic flow type having very low back pressure. It is double wrapped of heavy gauge galvanized steel with a layer of asbestos placed between wrappings to aid in reduction of noise transfer and to prevent any "oil-canning" effect. The exhaust system is supported by free hanging rubber-fabric mountings which permit free movement of the system but do not permit transfer of noise and vibration into the passenger compartment.

e. Dual Exhaust System

The dual exhaust system is optional on Series 46-4800 cars except estate wagons. Because of the different location of the gas tank on the estate wagons, dual exhaust cannot be installed on these models. Dual exhaust is standard on Riviera models.

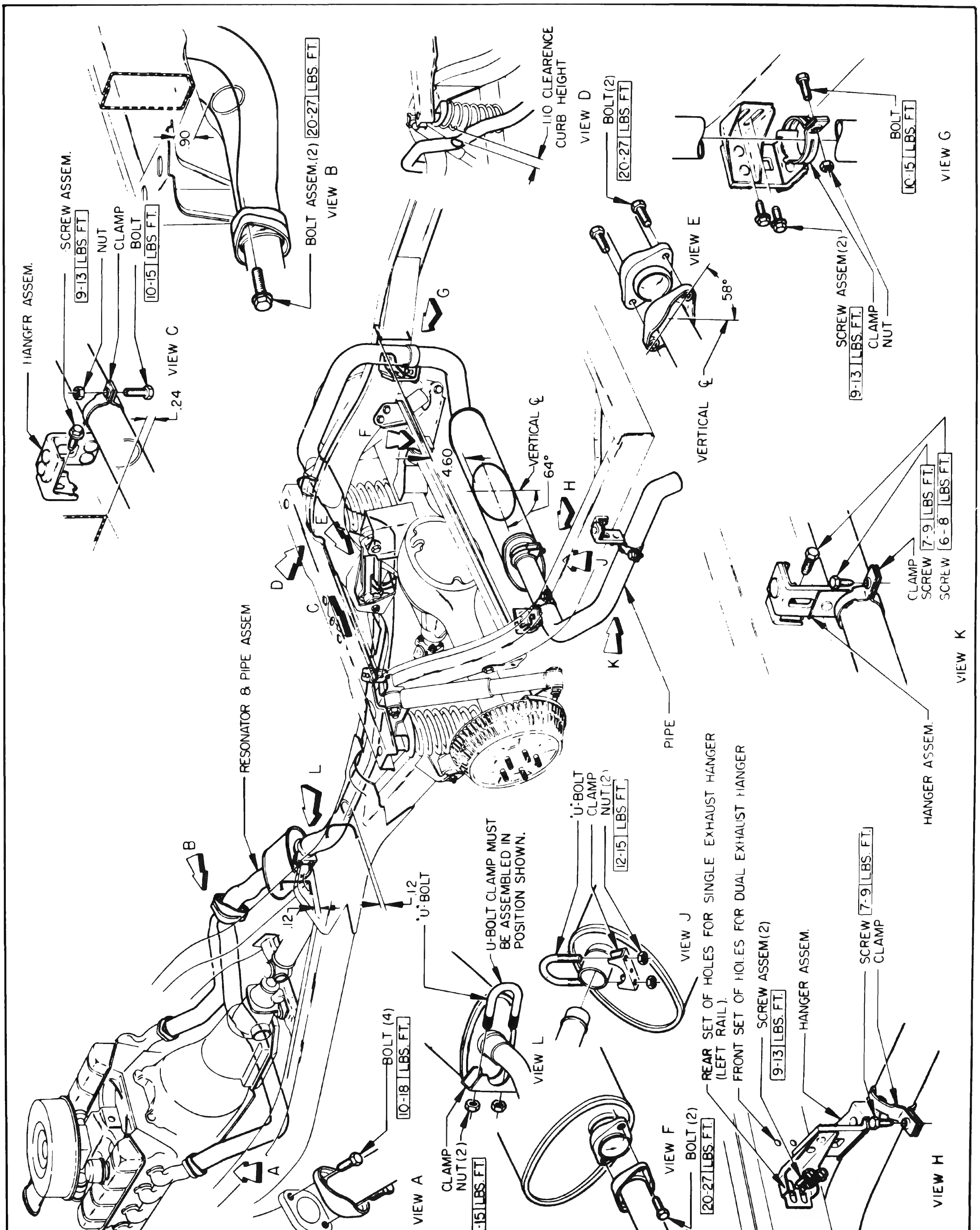


Figure 3-8—Single Exhaust System-4400 Series

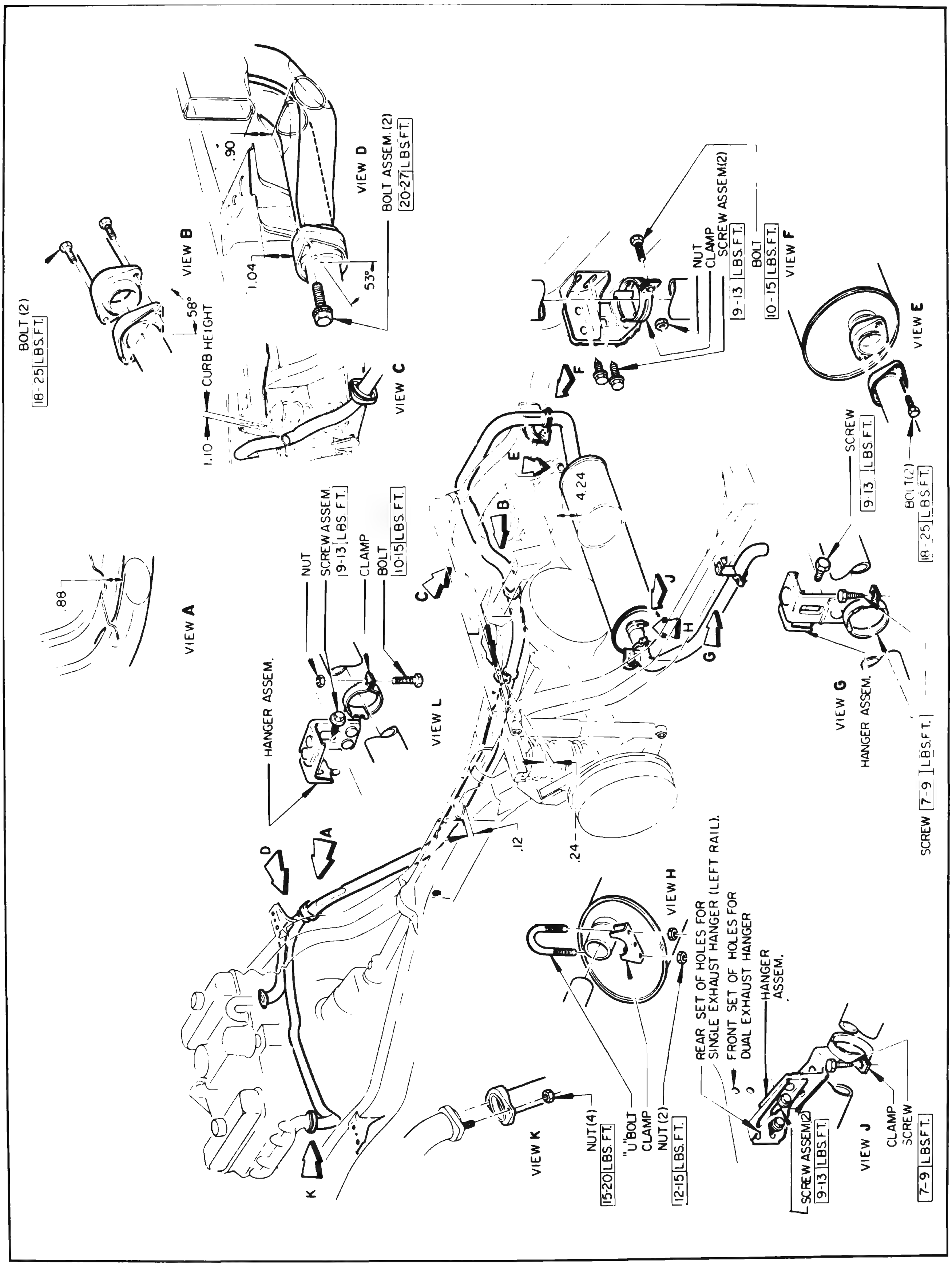


Figure 3-9—Single Exhaust System-46-4800 Series

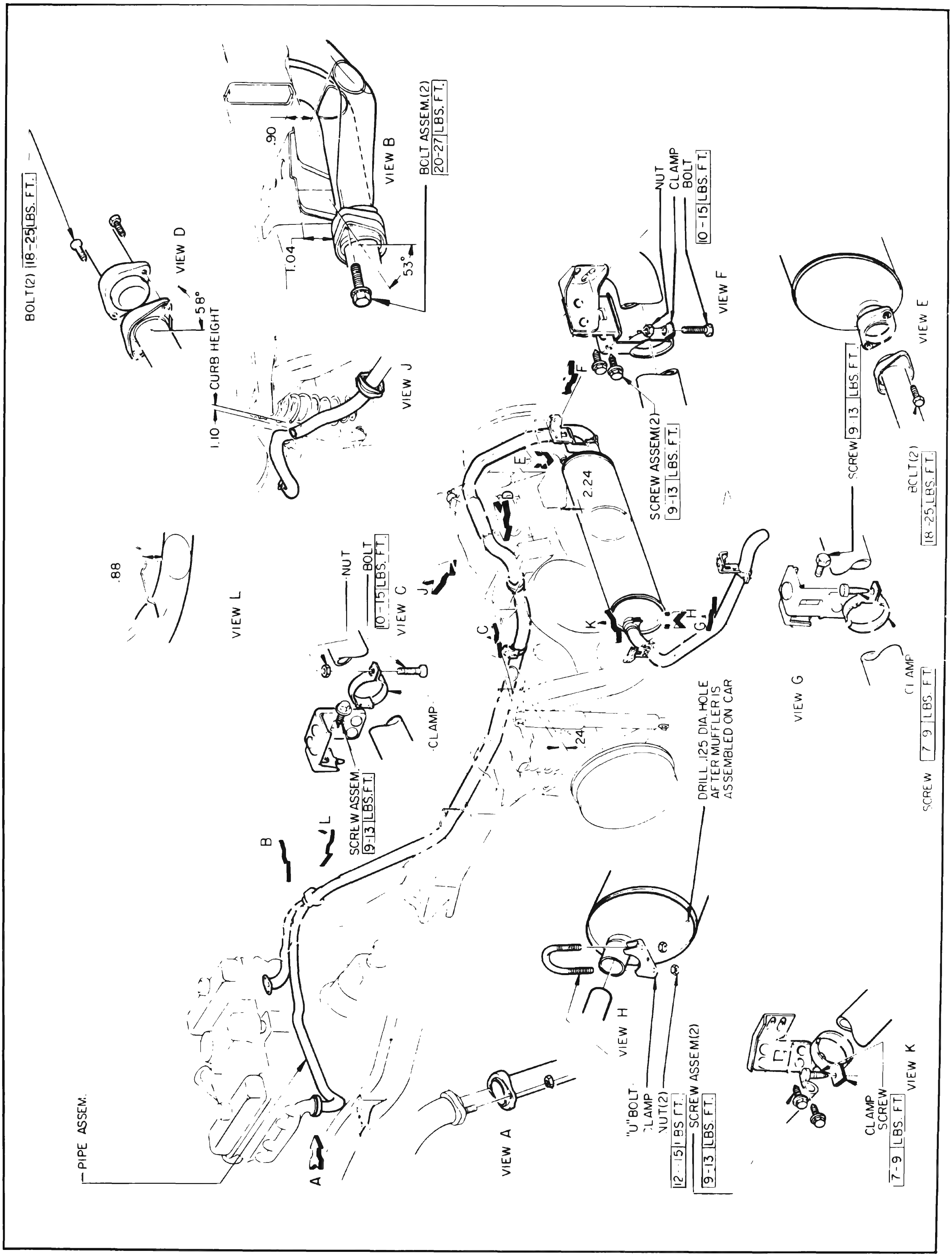


Figure 3-10—Single Exhaust System-Wagons

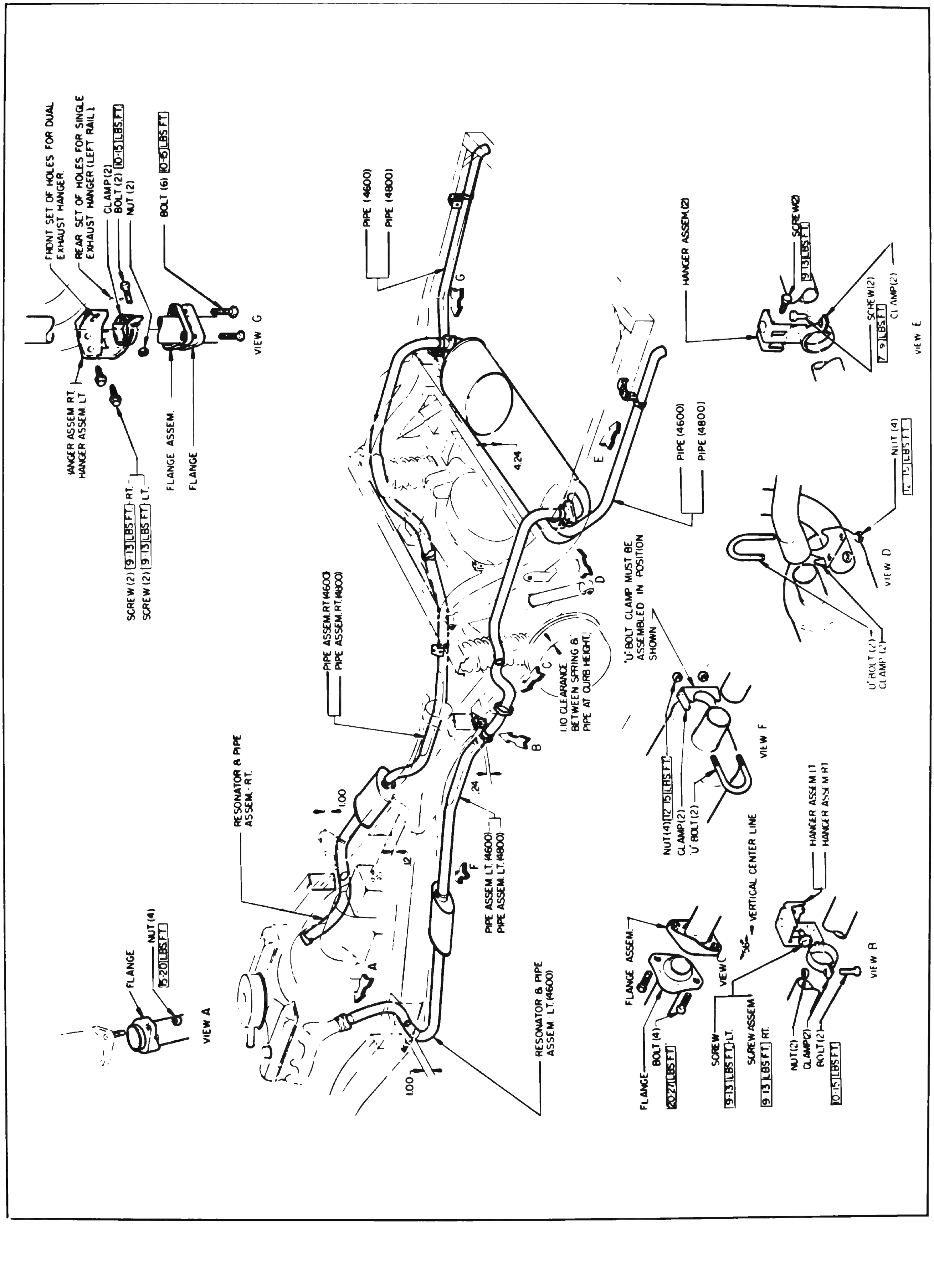


Figure 3-11—Dual Exhaust System-46-4800 Series

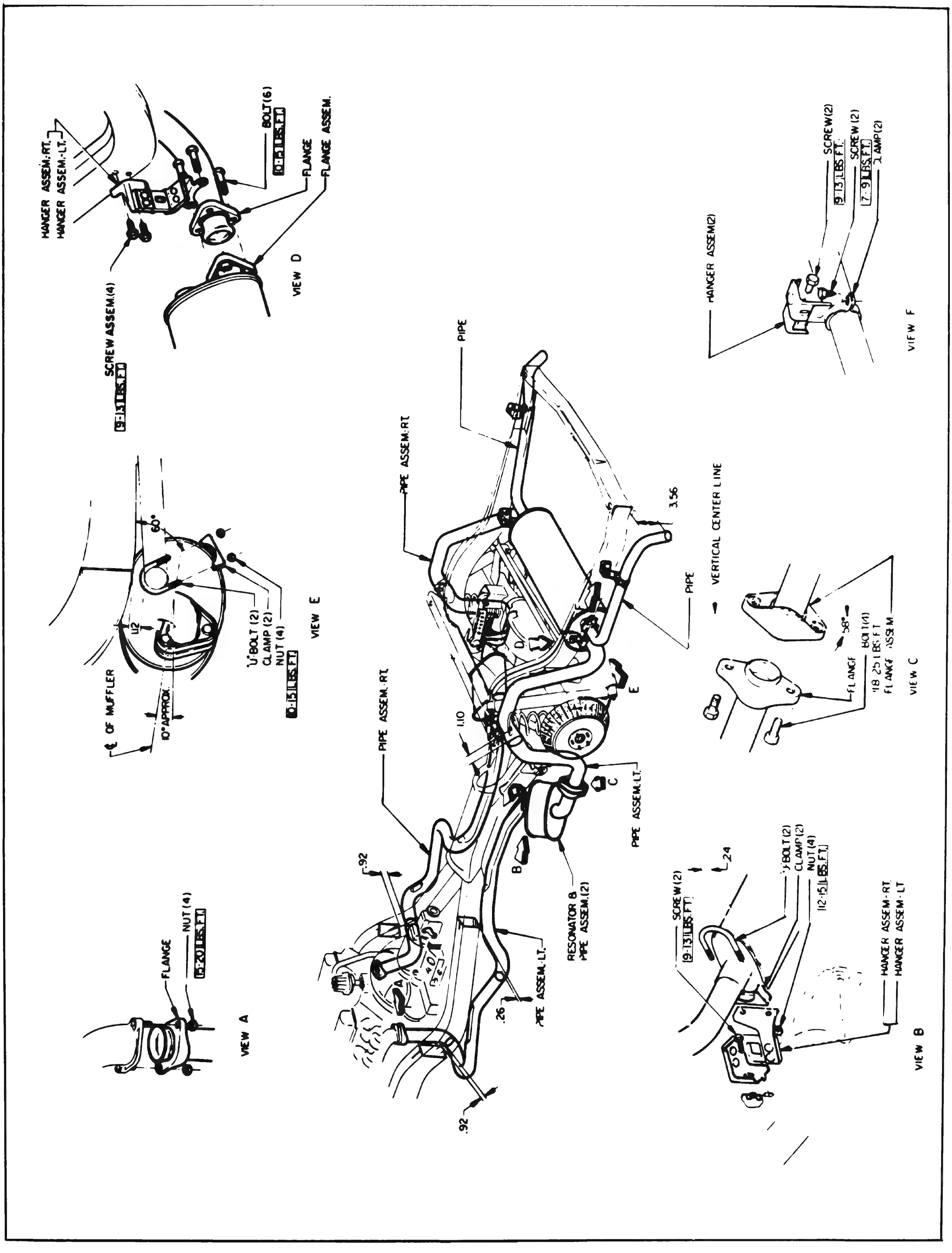


Figure 3-12—Dual Exhaust System-Rivieras

A single muffler is placed cross-wise at the rear of the car. See Figures 3-11 and 12. The muffler has an inlet and an outlet on each end. Each side of the dual exhaust system has a front exhaust pipe assembly having a resonator at the rear end. Each resonator is attached by a U-bolt and clamp. Each side has a short rear exhaust pipe just forward of the rear spring cross member. Each rear exhaust pipe is attached to the muffler inlet by a ball joint. A tail pipe is attached to each of the muffler outlets by a U-bolt and clamp. The muffler is supported by the rear exhaust pipe and tail pipe hangers. See Figures 3-11 and 12. Longer front and center exhaust pipes are used on the Series 4800 because of their longer wheel base. Also longer tail pipes are required on Series 4800 because of their longer rear overhang.

The exhaust gases from each bank of cylinders pass through individual resonating chambers in the muffler and then enter one common chamber. This common mixing of gases increases muffler silencing ability and eliminates the "cold side" muffler.

f. Single Exhaust System

The single exhaust system has the same construction features as the dual exhaust system. A smaller cross-wise muffler is used which has the inlet located on the right end and the outlet on the left end. See Figures 3-8, 9 and 10.

The single exhaust system has a front exhaust pipe assembly consisting of a branch pipe from each exhaust manifold welded together. A long center exhaust pipe extends along the right side of the frame back to the rear exhaust pipe. The rear exhaust pipe extends up over the rear axle along the outside of the frame, then crosses over the side rail and goes down to the right end of the muffler. A short tail pipe extends back from the left end of the muffler. All connections are ball joints except the tail pipe to muffler connection which is the U-bolt and clamp type. See Figures 3-8, 9 and 10.

A total of four hangers is used on the single exhaust system, the first located near the rear end of the center exhaust pipe, the second located near the muffler end of the rear exhaust pipe, the third at the muffler end of the tail pipe, and the last near the rear end of the tail pipe.

None of the parts are interchangeable between the single and dual exhaust systems except for some of the hangers. However, both right and left exhaust manifolds are the same for single or dual exhaust cars.

SECTION 3-B

FUEL SYSTEM TROUBLE DIAGNOSIS

CONTENTS OF SECTION 3-B

3-4 HARD STARTING

a. Improper Starting Technique

Hard starting may be due to improper starting technique. If possible, observe the owner's method of starting; if not correct, suggest that he use the following procedure.

1. Place control lever in "P" or "N" position. Starter cannot be operated in any other position.

2. Engine Cold. Depress accelerator pedal to floor once and release. This presets the automatic choke and throttle.

Engine Warm. Hold accelerator pedal about 1/3 down.

3. Turn ignition switch to "START" and release when engine starts. As soon as the engine is running smoothly, "jab" the accelerator pedal to slow the engine down to warm-up speed.

If engine "floods", hold accelerator to floor to open choke; then crank engine until it fires regularly.

If engine has not been started for several days, the carburetor may be dry due to evaporation. If engine does not start in normal time, depress accelerator pedal several times to pump any fuel accumulated in bottom of carburetor into the engine.

b. Improper Ignition

Before attempting any correction in fuel system make certain that the battery and ignition system are in proper condition. See paragraphs 10-13 and 10-33.

c. Improper Adjustment of Fast Idle Cam or Choke Unloader

An incorrectly adjusted fast idle cam may not provide insufficient throttle opening and stalling will result.

If the choke unloader goes into action too soon it may cause hard starting when engine is cold. If choke unloader goes into action too late or not at all, it may cause hard starting when engine is flooded. See paragraph 3-17 (Rochester 2-Bbl.), 3-21 (Carter), or 3-25 (Rochester 4-Bbl.).

d. No Fuel at Carburetor

No fuel may be delivered to carburetor due to empty gasoline tank or stoppages in filters, strainers or feed hoses, or inoperative fuel pump. Test fuel supply as described in paragraph 3-12.

e. Improper Carburetor Adjustment

Improper setting of carburetor idle needle valves may cause stalling after starting. A high fuel level in float bowl will cause flooding and consequent hard starting. Adjust carburetor (par. 3-8).

f. Low Grade Gasoline

Low grade gasoline is usually insufficiently volatile to provide easy starting in cold weather even though it may perform reasonably well after the engine is started and warmed up. A change to higher grade gasoline is the only remedy.

g. Volatile Gasoline

In some parts of the country, gasoline are marketed which are very volatile and generally advertised as "easy starting gasolines." Some of these fuels are so volatile they boil (commonly referred to as "percolation") in a carburetor bowl which is only normally warm, especially when the engine is shut off following a run. This overloads the manifold, resulting in an over rich mixture which may cause "delayed" starting.

Such gasolines are not necessary in a Buick since the automatic choke has been designed and calibrated to provide easy and positive starting with fuels of ordinary volatility, but if the owner wishes to use volatile gasolines the automatic choke thermostat should be adjusted for a "lean" setting (par. 3-8).

3-5 IMPROPER ENGINE PERFORMANCE

a. Engine Idles Too Fast

A cold engine should operate on fast idle for two to five minutes depending on air temperature. At 32°F. the fast idle cam should move to slow idle position in approximately 1/2 to 3/4 mile of driving. At higher temperatures it should move to slow idle position in a correspondingly shorter distance.

If the engine operates too long on the fast idle cam, check the choke thermostat setting (par. 3-8) and the fast idle adjustment. See paragraph 3-17 (Rochester 2-Bbl.), 3-21 (Rochester 4-Bbl.), or 3-25 (Carter).

If engine idles faster than the specified idle speed when off the fast idle cam, check throttle linkage for binding or weak return spring and adjust throttle stop screw (par. 3-8). This trouble can also be caused by a sticking choke or dash pot.

b. Improper Idle and Low Speed Performance

Rough idling and tendency to stall may be caused by idling speed set below the specified speed. Idle mixture may be wrong due to improper needle valve adjustment (par. 3-8).

Rough idling, poor performance, and back firing at low speeds frequently originates in improper ignition. Check ignition system (par. 10-33).

High fuel pump pressure will cause rough idling and poor low speed performance (par. 3-12).

An intake manifold air leak will cause rough idling and poor low speed performance. A manifold air leak produces a low, erratic reading on a vacuum gauge connected to the intake manifold. Check for leaks at all pipe connections and check manifold joints with gasoline.

When rough idling and poor low speed performance cannot be corrected by checks of carburetion and ignition mentioned above, check cylinder compression.

Improper performance which is most noticeable at low speeds may be caused by sticking valves. Sticking valves may be caused by the use of low grade fuel or fuel that has been in storage too long. <u>When a car is stored for any length of time, fuel should be drained from the tank, feed hoses, fuel pump, and carburetor in order to avoid gum formation.</u>

c. Improper High Speed Operation

Roughness or poor performance above 22 MPH indicates faulty ignition (par. 10-33) or improper settings in the high speed circuit of carburetor. Surging at high speed may be caused by low fuel pump pressure (par. 3-12).

With Rochester carburetors, surging at 75 to 80 MPH constant speed indicates that the power jet is stopped up or the vacuum piston is sticking.

If there is lack of power at top speed, check throttle linkage to insure full throttle valve opening (par. 3-9).

d. Excessive Detonation or Spark Knock

<u>Light detonation</u> may occur when operating an automatic transmission car in Drive with full throttle at low speed even when ignition timing is correct and proper fuel is used. This light detonation is normal and no attempt should be made to eliminate it by retarding the ignition timing, which would reduce economy and over-all performance.

<u>Heavy detonation</u> may be caused by improper ignition timing (par. 10-35), improper grade of fuel, or by an accumulation of carbon in combustion chambers. Series 4400 cars with the low compression engine may use regular fuel; all others require premium fuel because of their higher compression ratios.

Heavy detonation is injurious to any automotive engine. A car driven continuously under conditions and with fuels which produce heavy detonation will overheat and lose power, with the possibility of damage to pistons and bearings.

3-6 EXCESSIVE FUEL CONSUMPTION

Complaints of excessive fuel consumption require a careful investigation of owner driving habits and operating conditions as well as the mechanical conditions of the engine and fuel system; otherwise, much useless work may be done in an attempt to increase fuel economy.

Driving habits which seriously affect fuel economy are: high speed driving, frequent and rapid acceleration, driving too long in a low speed range when getting under way, excessive idling while standing.

Operating conditions which adversely affect fuel economy are: excessive acceleration, frequent starts and stops, congested traffic, poor roads, hills and mountains, high winds, low tire pressures.

High speed is the greatest contributor to low gas mileage. Air resistance increases as the square of the speed. For instance, a car going sixty miles an hour must overcome air resistance four times as great as when going thirty miles an hour. At eighty miles an hour the resistance is over seven times as great as when going thirty miles an hour.

Over seventy-five per cent of the power required to drive a car eighty miles an hour is used in overcoming air resistance, while at thirty miles an hour only thirty per cent of the power required is used to overcome air resistance.

Gas mileage records made by car owners never give a true picture of the efficiency of the engine fuel system since they include the effects of driving habits and operating conditions. Because of the wide variation in these conditions it is impossible to give average mileage figures for cars in general use; therefore, any investigation of a mileage complaint must be based on an accurate measurement of gasoline consumption per mile under proper test conditions.

a. Gasoline Mileage Test

A gas mileage test should be made with a 1/10th gallon gauge on a reasonably level road, at fixed speeds, without acceleration or deceleration. Test runs should be made in both directions over the same stretch of road to average the effect of grades and wind resistance. Test runs made at 20, 40 and 60 MPH will indicate the approximate efficiency of the low speed, high speed, and power systems of the carburetor and show whether fuel consumption is actually abnormal. If a mileage test indicates that the fuel consumption is above normal, check the following items.

1. Fuel Leaks. Check all gasoline hose connections, fuel pump, gasoline filter, and carburetor bowl gasket.

2. Tires. Check for low tire pressures (par. 1-1).

3. Brakes. Check for dragging brakes.

4. Ignition Timing--Spark Plugs. Late ignition timing causes loss of power and increases fuel consumption, (par. 10-35). Dirty or worn out spark plugs are wasteful of fuel (par. 10-36).

5. Low Grade Gasoline. Use of gasoline of such low grade that ignition timing must be retarded to avoid excessive detonation will give very poor fuel economy.

6. Exhaust Manifold Heat Valve. Check for sticking valve or improper setting of thermostat (par. 3-7).

7. Air Cleaner. Check for dirty or clogged cleaner element. (Par. 3-7).

8. Automatic Choke. Check for sticking choke valve and improper setting of thermostat (par. 3-8).

9. Valves. Check for sticking valves (par. 2-11).

10. Fuel Pump. Check for excessive fuel pump pressure (par. 3-12).

11. Carburetor Adjustment. Check idle adjustment (par. 3-8). For corrections to high speed and power systems, the carburetor must be removed and disassembled.

b. Changing Carburetor Calibrations

Under no circumstances should the jet sizes, metering rods and other calibrations of a carburetor be changed from factory specifications. The calibrations given in paragraph 3-1 must be adhered to unless these are later changed by a bulletin issued from the Buick Factory Service Department.

SECTION 3-C
ADJUSTMENTS AND REPLACEMENTS—EXCEPT IN PUMP AND CARBURETOR ASSEMBLIES

CONTENTS OF SECTION 3-C

3-7 AIR CLEANER, FUEL FILTER, MANIFOLD VALVE AND VENTILATOR VALVE SERVICE

a. Air Cleaner Service

An air cleaner with a dirty element will restrict the air flow to the carburetor and cause a rich mixture at all speeds. The device will not properly remove dirt from the air and the dirt entering the engine will cause abnormal formation of carbon, sticking valves, and wear of piston rings and cylinder bores.

Regular cleaning and inspection of the element at 12000 mile intervals (or more frequently in dusty territory) is necessary to prevent excessive engine wear and abnormal fuel consumption. The procedure for cleaning the air cleaner is given in paragraph 1-1.

b. Cleaning Fuel Filter

The fuel filter is a can-type throw-away filter and is located in the line between the fuel pump and the carburetor.

The filter element has a large filtering area. It is of fine enough material to assure that any particles which pass through it are too small to interfere with the operation of the float needle and seat, and also too small to cause clogging of the smallest passages

Figure 3-13—Can-Type Throw-Away Fuel Filters

in the carburetor. This filter prevents the passage of water under ordinary conditions. The filter should be replaced every 24000 miles for maximum filtering efficiency. See paragraph 1-1.

After assembling the fuel filter, always start the engine and observe the filter carefully to make sure that the clamps are not leaking.

A woven plastic filter is located on the lower end of the fuel pickup pipe in the gas tank. This filter prevents dirt from entering the fuel line and also stops water unless the filter becomes completely submerged in water. This filter is self cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the gas tank contains an abnormal amount of sediment or water; the tank should therefore be removed and thoroughly cleaned.

c. Cleaning Carburetor Gasoline Strainers

Fine mesh strainers are located in some carburetors above each needle and seat. These strainers should seldom require cleaning because of the fuel filter which precedes them in the supply line. They should be inspected however, if fuel supply at carburetor inlet is adequate but carburetor operation indicates lack of fuel.

d. Freeing Up Sticking Exhaust Manifold Valve—401 and 425 Engines

Lubricate the exhaust manifold flange shaft every 6000 miles (par. 1-1).

Carbon or lead salt deposits around the valve shaft may cause the valve to stick or become sluggish in operation. A valve sticking in the open position will cause slow engine warm up, excessive spitting and sluggish engine operation when cold. A valve sticking in the closed position will cause overheating, loss of power, and hard starting when the engine is hot, and may also cause warped or cracked manifolds. Sticking in either position will adversely affect fuel economy.

If the manifold heat control valve is sticking or seized in the flange assembly, free it up by applying a good solvent such as "Buick Heat Trap Lubricant" to the

valve shaft and bushings at both sides of the flange. Allow the solvent to soak for a few minutes, then work the valve by rotating the counterweight. Severe cases may be freed by tapping endwise on the shaft with a light hammer. After the shaft is free, another application of lubricant will assure complete penetration of the shaft bushings.

e. Checking Manifold Valve Thermostat Setting—401 and 425 Engines

The setting of the exhaust manifold valve thermostat may be checked when the engine is at room temperature of approximately 70°F. Unhook the outer end of thermostat from anchor pin on the manifold and hold the valve in the closed position. To bring the end of thermostat to the anchor pin will then require approximately 1/2 turn wind-up of the thermostat as shown in Figure 3-14.

The thermostat is not adjustable and should never be distorted or altered in any way as this will affect its calibration. If the thermostat does not have the proper setting, or is damaged, it should be replaced.

Fully open and fully closed positions of the exhaust manifold valve may be checked by the position of the heavy section of the manifold

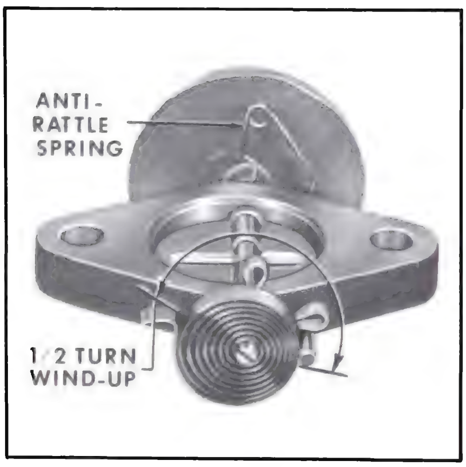


Figure 3-14—Manifold Valve Thermostat Wind-Up

Figure 3-15—Manifold Heat Control Valve Positions

valve weight. If the heavy section is to the rear and approximately 45 degrees up, the valve is fully closed; if the heavy section is forward and approximately 45 degrees up, the valve is fully open. See Figure 3-15.

f. Positive Crankcase Ventilator System Service

All cars have a positive crankcase ventilating system to help reduce air pollution and to provide more complete scavenging of crankcase impurities. Ventilation air is drawn in through the filter in the filler cap on the left rocker arm cover, down into the crankcase, across and up into the right rocker arm cover, up through the ventilator valve, through a hose, into the carburetor throttle body and into the intake manifold. Intake manifold vacuum draws any fumes from the crankcase to be burned in the engine.

When air flow through the carburetor is high, added air from the positive crankcase ventilating system has no noticeable effect on engine operation; however, at idle speed, air flow through the carburetor is so low that any large amount added by the ventilating system would upset the air-fuel mixture, causing rough idle. For this reason, a flow control valve is used which restricts the ventilating system flow whenever intake manifold vacuum is high.

After a period of operation, the ventilator valve may become clogged, which reduces and finally stops all crankcase ventilation. An engine which is operated without any crankcase ventilation can be damaged seriously. Therefore, it is important to replace the ventilator valve periodically (each time the engine oil filter is replaced). CAUTION: <u>If an engine is idling too slow or rough, this may be caused by a clogged ventilator valve; therefore, never adjust the carburetor idle without first checking the crankcase ventilator check valve.</u>

With the crankcase ventilator system operating normally, about 1/4 of the air used in the idle mixture is supplied through the ventilator valve. Therefore, if the ventilator air is shut off, the idle speed will be noticeably slower. Check operation of the ventilator system as follows:

1. Connect a reliable tachometer and adjust idle as specified.

2. Squeeze-off crankcase ventilator hose to stop all air flow.

3. If idle speed drops 60 RPM or more, crankcase ventilator system is okay.

4. If idle speed drops less than 60 RPM, ventilator system is probably partially clogged; install

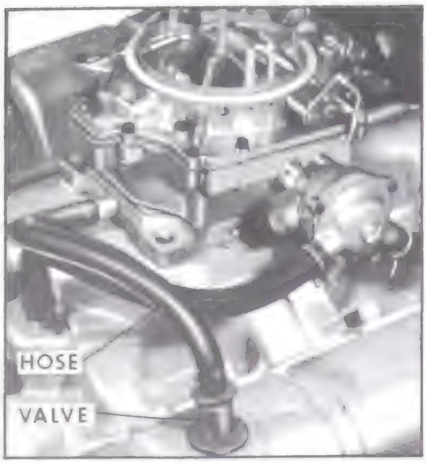


Figure 3-16—Positive Crankcase Ventilator System-300 Engine

a new ventilator valve and recheck operation of system as described above.

5. After installing a new ventilator valve, always readjust engine idle.

3-8 CARBURETOR IDLE AND AUTOMATIC CHOKE ADJUSTMENTS

Carburetor adjustment should not be attempted until it is known that engine ignition and compression are in good order. Any attempt to adjust or alter the carburetor to compensate for faulty conditions elsewhere in items affecting engine performance will result in reduced fuel economy and overall performance.

a. Idle Speed and Mixture Adjustments

The positive crankcase ventilator valve should be checked as described in paragraph 3-7 before making carburetor adjustments, as this valve noticeably affects the air-fuel ratio at idle.

1. Remove air cleaner. Connect a tachometer from distributor terminal of coil to ground.

2. Start engine and run it at fast idle until upper radiator tank is hot and choke valve is wide open.

CAUTION: Idle speed and mixture adjustments cannot be made satisfactorily with an abnormally hot engine. On any carburetor with a hot idle compensating valve, it is particularly important that idle adjustments be made at normal temperature so that this valve will be closed.

3. On automatic transmission cars, place a block in front of a front wheel and apply parking brake firmly, then shift transmission into drive.

4. Adjust throttle stop screw to set idle speed at 500 RPM (550 with air conditioner).

CAUTION: On Series 4400 automatic transmission cars, make sure that idle stator switch is closed while adjusting idle. See paragraph 3-9, c.

5. Adjust idle mixture needles alternately to obtain highest tachometer reading.

6. Readjust throttle stop screw to reduce idle speed to specifications. If idle speed was reduced very much, readjust idle mixture needles slightly for highest tachometer reading and smoothest engine idle.

7. If carburetor is equipped with a hot idle compensating valve, press a finger on valve to make sure it was closed. If idle speed drops, valve was open; readjust idle speed and mixture, making sure valve remains closed.

b. Automatic Choke Adjustments

The choke thermostat is calibrated to give satisfactory performance with regular blends of fuel when it is placed at the standard factory setting, which is listed in the specifications for each carburetor.

When it is necessary to adjust the thermostat, loosen the housing or cover attaching screws and turn as required.

Thermostat settings other than standard should be used only when the car is habitually operated on special blends of fuel which do not give satisfactory warm-up performance with the standard setting. A "Lean" setting may be required with highly volatile fuel which produces excessive loading or rolling of engine on warm-up with the standard thermostat setting. A "Rich" setting should be used only when excessive spitting occurs on engine warm-up with the standard thermostat setting. When making either a "Lean" or "Rich" setting, change one point at a time and test results with engine cold, until the desired performance is obtained.

If the engine operates on fast idle too long after starting or else moves to slow idle too soon, or the choke unloader does not operate properly, check the fast idle and choke unloader adjustments.

3-9 THROTTLE LINKAGE AND TRANSMISSION SWITCH ADJUSTMENTS

NOTE: Throttle linkage adjustment on dual 4-barrel cars is covered in paragraph 3-28.

The procedure for adjusting the throttle linkage is identical on synchromesh and automatic transmission cars. On Series 4400 automatic transmission cars, however, the throttle linkage also actuates two transmission switches connected by wires to two solenoid valves located inside the transmission. Series 46-47-4800 automatic transmission cars have only one transmission control switch. Whenever the throttle linkage is adjusted on an automatic transmission car, the transmission switches should also be checked and adjusted if necessary.

a. Throttle Linkage Adjustment

1. Remove air cleaner. Check throttle linkage for proper lubrication. Make sure that linkage

is free in all positions and that return spring fully closes the throttle, even though throttle is released very slowly.

2. Unsnap front end of throttle operating rod from carburetor throttle lever. See Figure 3-17. While another man presses accelerator pedal against floor mat, hold carburetor throttle lever in wide open position and hold throttle rod socket in alignment with ball on throttle lever. Socket must be approximately 1/16 inch (2 turns) short of ball. If adjustment is necessary, loosen lock nut, adjust throttle rod length as required, and retighten lock nut.

3. With accelerator pedal released, reinstall throttle rod on throttle lever. With accelerator pedal pressed again to floor mat, recheck throttle for wide open position.

b. Transmission Detent Switch Adjustment (Automatic Transmission Cars)

On all automatic transmission cars, a transmission detent switch is mounted at the full throttle position of the carburetor throttle lever. When the throttle linkage is moved to wide open throttle position, the switch contacts are closed to cause the transmission to "downshift".

On 2-speed automatic transmission cars only, the switch also has a second set of contacts which close slightly before wide open throttle position to cause the stator blades in the transmission to "switch-the-pitch" to high performance angle. See Figures 3-17 and 3-18.

To adjust either type of detent switch, hold carburetor at wide open throttle and adjust switch plunger so that it is approximately .050 inch from bottom.

c. Idle Stator Switch Adjustment (Automatic Transmission Cars)

Used only with the 2-speed automatic transmission, this switch closes just before the throttle reaches slow idle position; this causes a solenoid valve in the transmission to operate, which, in turn, causes the stator blades to "switch-the-pitch" to high angle. This reduces the transmission load on the engine at idle, thereby reducing the tendency of the car to creep. See Figure 3-17.

Before adjusting the idle stator switch, engine idle speed and mixture must be adjusted. Adjust as follows:

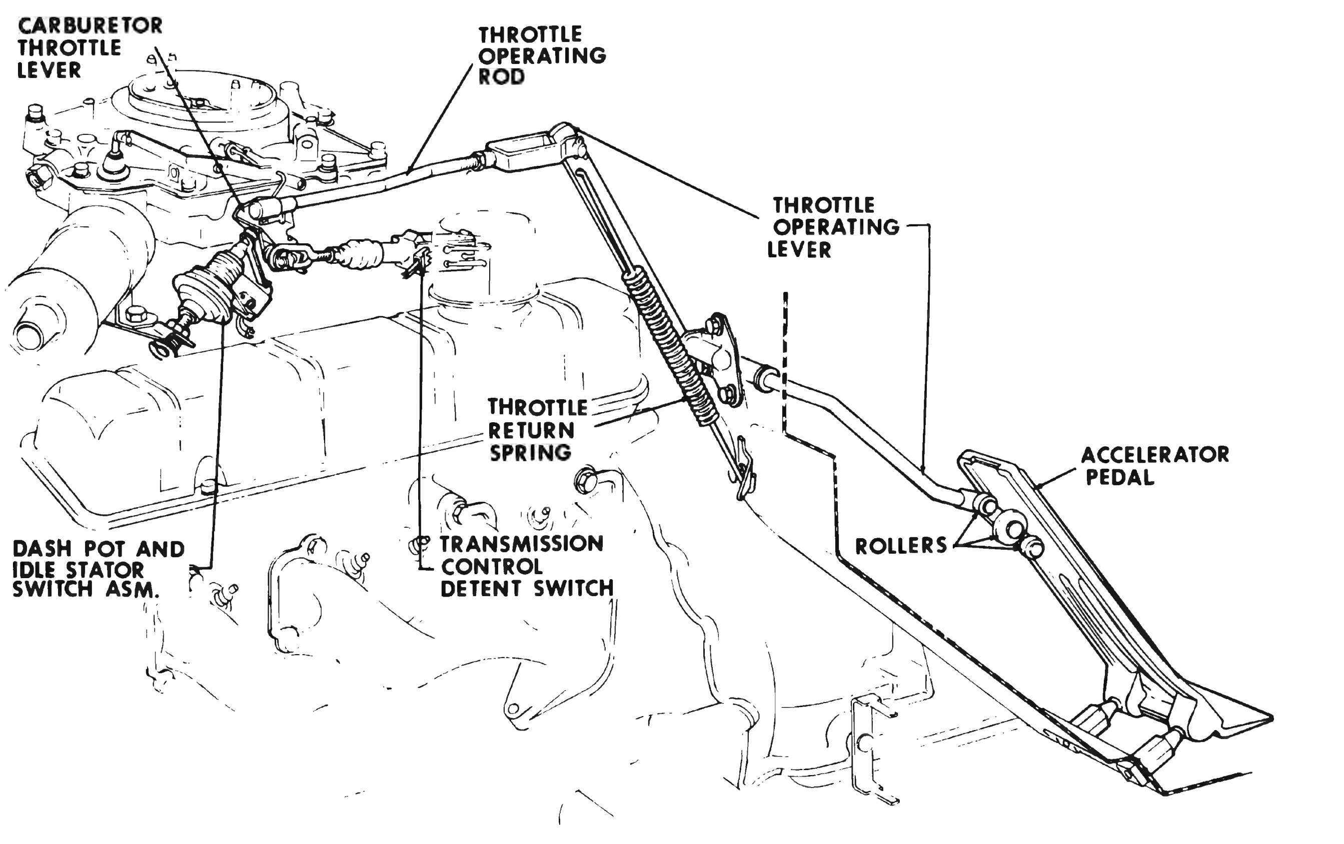


Figure 3-17—Throttle Linkage and Transmission Control Switches-300 Engine

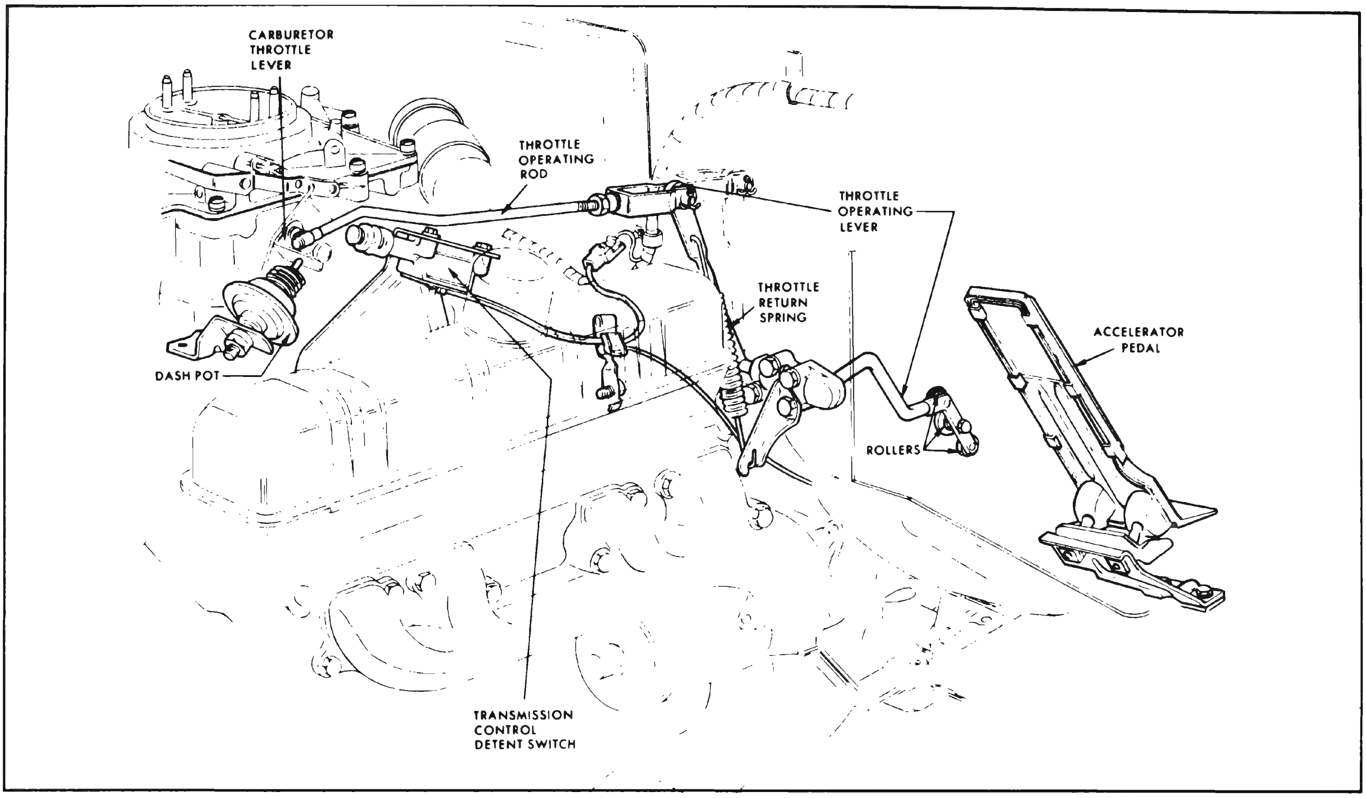


Figure 3-18—Throttle Linkage and Transmission Control Switch-401 and 425 Engines

1. Normalize engine temperature; adjust engine idle speed and mixture. See paragraph 3-8.

2. Shut engine off. Unplug idle stator switch connector and plug prods of a test light (such as Diode Test Light J-21008) into end of connector.

3. Turn stator switch adjusting nut to back switch away from throttle lever until test light is out (switch open).

4. Turn adjusting nut to move stator switch toward throttle lever until light just comes on, then turn ten flats (ten notches) in addition, to make sure switch always closes at idle.

5. Remove test light and reconnect stator switch connector.

d. Dash Pot Adjustment (3-Speed Automatic Transmission Cars)

1. Loosen dash pot lock nut.

2. With carburetor closed to curb idle position, rotate dash pot until plunger just touches throttle lever. Make a reference mark on dash pot, then rotate it 5 full turns toward throttle lever (depressing plunger).

3. Retighten lock nut.

3-10 REPLACEMENT OF GAS TANK OR GAS GAUGE TANK UNIT

a. Description

In all series of large cars, three different gas tanks are used. Series 4400-4600-4800 cars except estate wagons have a tank which is located in the kick-up area over the rear axle and is held in place with four bolts through the tank flange; estate wagons have a different tank which is located to the rear of the single exhaust system muffler and is held in place with two straps. Rivieras have a different tank which has the filler located in the rear center.

A total of six different tank units are required, because, if the car is equipped with air conditioning, the tank unit must have two pipes - the feed pipe and a vapor return pipe.

b. Removing and Installing Gas Gauge Tank Unit (Except Station Wagons and Rivieras)

It is not necessary to remove the gas tank to replace the tank unit as there is an access hole in the trunk shelf through which the tank unit can be removed. Remove the unit as follows:

1. Remove spare tire and wheel.

2. Remove access hole cover screws and pry up access cover.

3. Disconnect gas hose or hoses. Disconnect wire. Remove tank unit retaining screws and remove tank unit.

4. Install new tank unit and gasket in reverse order of above steps. Make sure access hole cover has sealing compound around the edge for a water-tight seal.

c. Removing Gasoline Tank (Except Estate Wagons and Rivieras)

1. Siphon gasoline from tank. A convenient way is to disconnect rubber hose from forward end of steel line along right frame side rail. Then slip siphon hose over end of steel line.

2. Remove muffler - tail pipe assembly as a unit.

3. Loosen bolt in right end of track bar. Remove bolt from left end of track bar and push left end of track bar down out of the way.

4. Remove three bolts which fasten right end of track bar cross member to frame. Remove track bar cross member from car.

5. Disconnect breather hose from breather U-tube in body near upper left side of tank.

6. Disconnect tank filler by sliding filler pipe up until clear of gas tank. See Figure 3-19.

7. Disconnect gas gauge wire at connector over right frame side rail.

8. Disconnect gas tank hose from rear end of steel line along right frame side rail.

9. Remove two nuts from front edge of tank and two bolts from rear edge of tank. Lower tank.

d. Installing Gasoline Tank (Except Estate Wagons and Rivieras)

1. Install gas gauge tank unit in tank. Connect gas hose and gas gauge wire to tank unit. Connect breather hose at upper left side of tank.

2. Raise gas tank into position. Install two bolts in rear edge of tank and two nuts on studs at front edge of tank.

3. Connect gas tank hose to rear end of steel line.

4. Connect gas gauge wire at connector over right frame side rail.

5. Clean and oil lower 2 inches of filler pipe. Connect tank filler by sliding filler pipe down into "O" ring seal in tank neck.

6. Connect breather hose to forward breather tube.

7. Fasten right end of track bar cross member loosely to frame.

8. Install large bolt through left end of track bar cross member.

Tighten right end of cross member to frame bolts to 50 ft. lbs. Tighten track bar bolts to 100 ft. lbs.

CAUTION: Car must be at trim height while tightening track bar bolts so that rubber bushings will be in a neutral position.

9. Install muffler - tail pipe assembly.

10. Lower car and check gas gauge for correct empty reading.

11. Fill gas tank and again check gauge reading. Check for gasoline leaks.

e. Removing and Installing Gasoline Tank (Estate Wagons and Rivieras)

Estate wagon and Riviera gasoline tanks are located in a completely different location - to the rear of the muffler. See Figure 3-20 or 21. Therefore, it is not necessary to remove any other parts before removing the gas tank. The tank is held in place by two straps and two nuts.

On the estate wagon or Riviera, the gasoline tank must be lowered to remove and install a gas gauge tank unit.

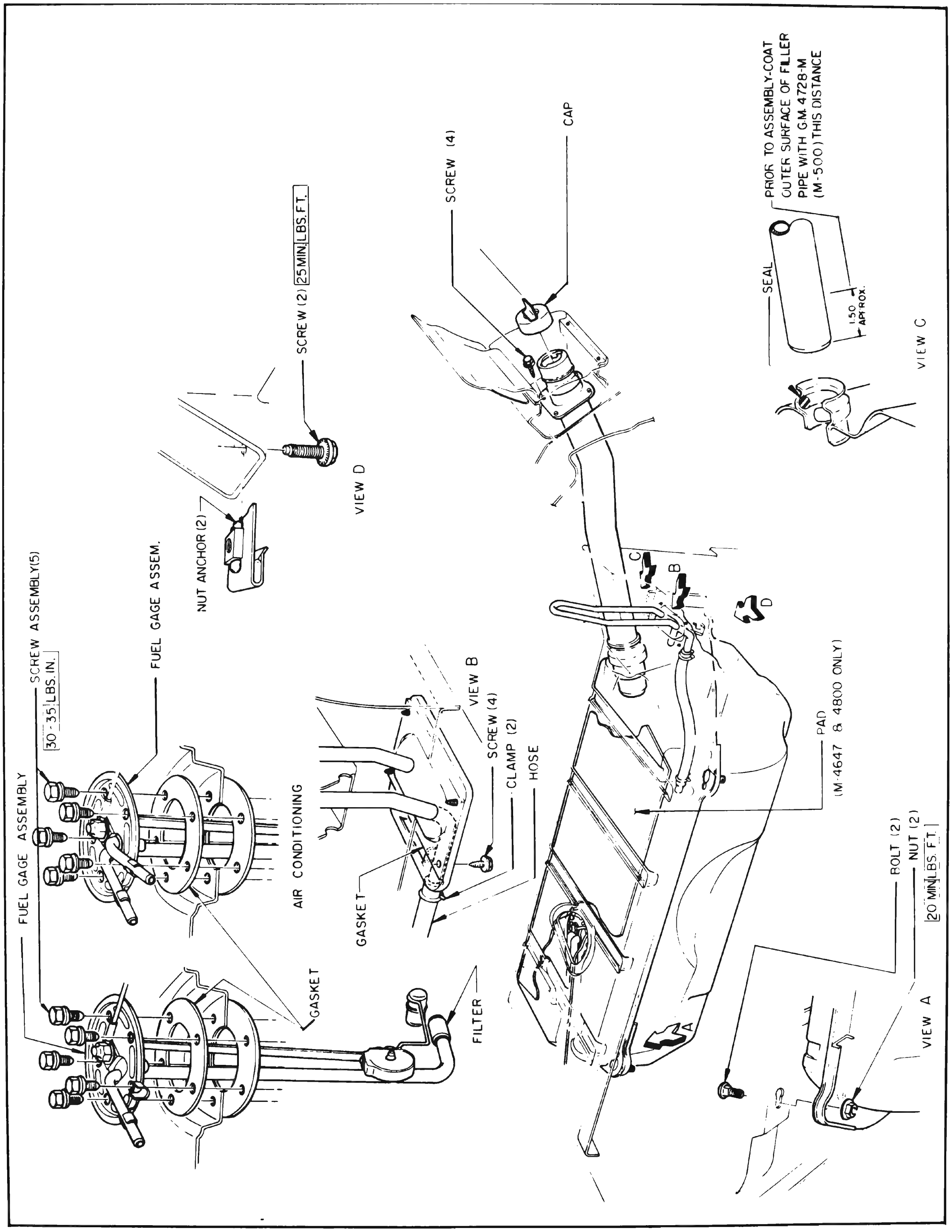


Figure 3-19—Fuel Tank

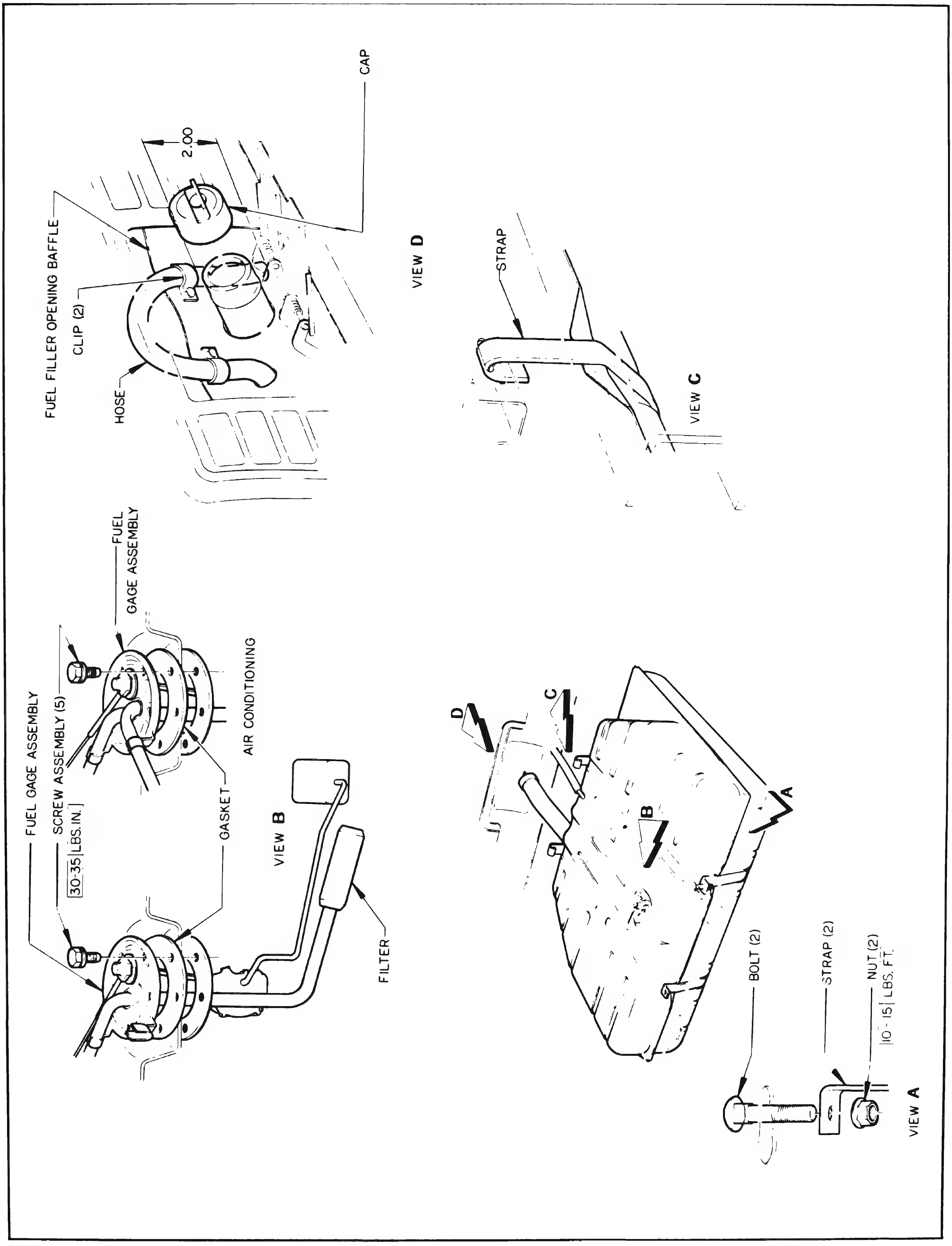


Figure 3-20—Fuel Tank-Rivieras

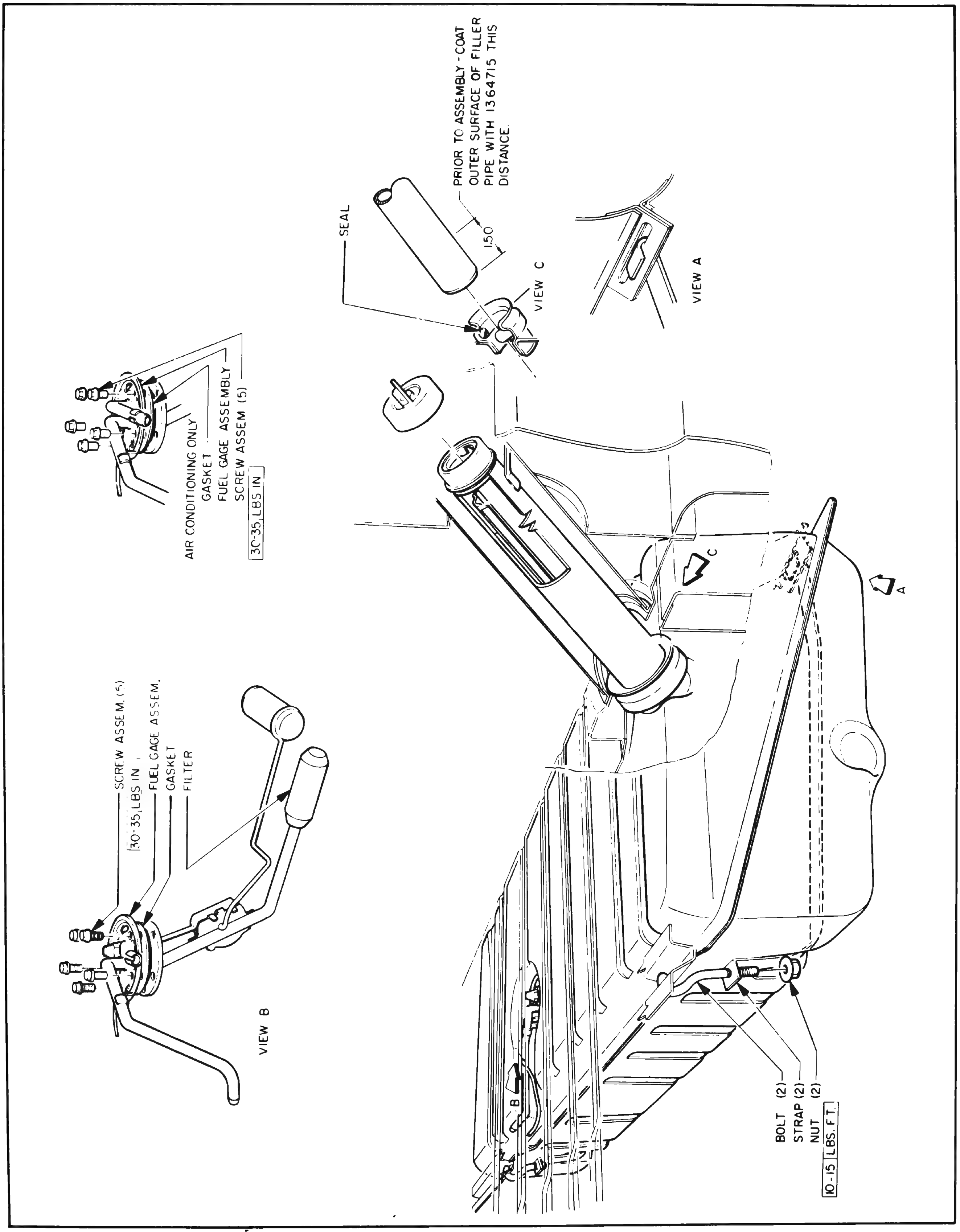


Figure 3-21—Fuel Tank-Wagons

SECTION 3-D
FUEL PUMP

CONTENTS OF SECTION 3-D

3-11 DESCRIPTION AND OPERATION OF TYPE HE FUEL PUMP

a. Description of Pump

An AC Type HE fuel pump is used on all engines. The pump assembly is mounted on the right side of the timing chain cover in an inverted position, and the pump rocker arm is actuated by an eccentric mounted on front side of the camshaft sprocket.

The fuel pump has a built-in air dome with a diaphragm to dampen out pulsations in the fuel stream. It is a diaphragm type pump and is actuated by the rocker arm through a link and a pull rod. See Figure 3-22.

b. Operation of Fuel Pump

The fuel pump draws gasoline from the tank and supplies it to the carburetor in sufficient quantity to meet engine requirements under all operating conditions. The principle parts of the fuel section are shown in Figure 3-22.

The rocker arm spring holds the rocker arm in constant contact with the eccentric on the engine camshaft sprocket so that the rocker arm swings up and down as the camshaft rotates. As the arm swings downward, it bears against a shoulder on the link which is pivoted on the rocker arm pin. The link swings upwards, thereby pulling the fuel diaphragm upward by means of the connecting pull rod.

Upward movement of the fuel diaphragm compresses the diaphragm spring and also creates a vacuum in the fuel chamber

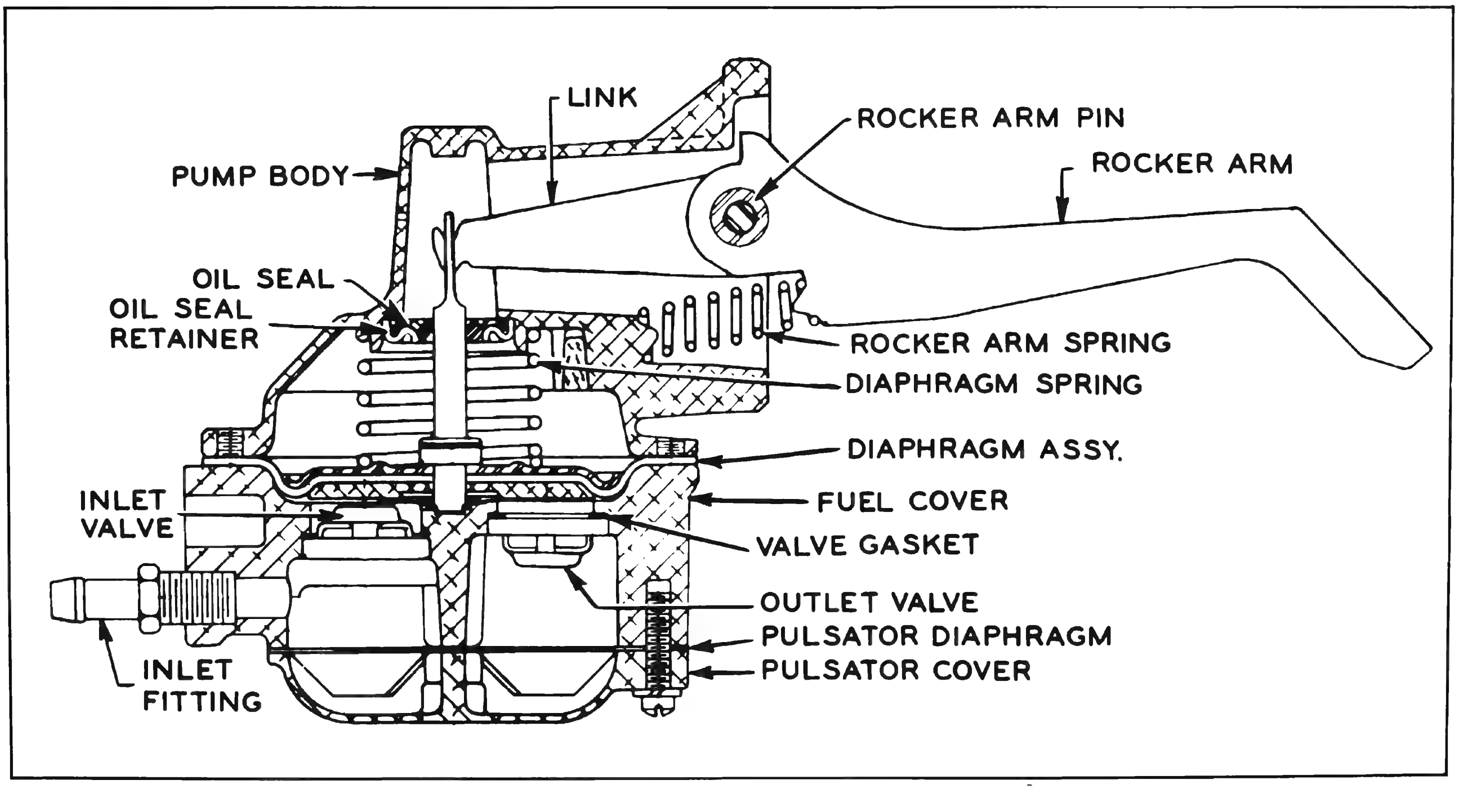


Figure 3-22—Type HE Fuel Pump

under the diaphragm. The vacuum causes the outlet valve to close and causes fuel from the gasoline tank to enter the fuel chamber through the inlet valve.

As the rotating eccentric permits the rocker arm to swing upward, the arm releases the fuel link; it cannot move the link downward. The compressed diaphragm spring then exerts pressure on the diaphragm and the fuel in the chamber below diaphragm. This pressure closes the inlet valve and forces fuel out through the outlet valve to the carburetor.

Since the fuel diaphragm is moved downward only by the diaphragm spring, the pump delivers fuel to the carburetor only when the pressure in the outlet line is less than the pressure maintained by the diaphragm spring. This condition arises when the carburetor float needle valve is not seated and the fuel passage from the pump into the carburetor float chamber is open. When the needle valve is closed and held in place by the pressure of the fuel on the float, the pump builds up pressure in fuel chamber until it overcomes the pressure of the diaphragm spring. This pressure results in almost complete stoppage of diaphragm movement until more fuel is needed.

The air dome with diaphragm in the bottom of fuel pump provides a pocket in which fuel under pressure can compress a certain volume of air. When the pressure is relieved (pump on suction stroke) the pocket of compressed air pushes the fuel on to its destination. The air dome minimizes flow variations experienced with two-cycle pump stroke and increases the pump output.

3-12 FUEL PUMP INSPECTION AND TEST

If the fuel system is suspected of delivering an improper amount of fuel to the carburetor, it should be inspected and tested on the engine, as follows:

a. Inspection of Fuel System

1. Make certain that there is gasoline in the tank.

2. Clean the gasoline filter (par. 3-7).

3. With engine running, inspect for leaks at all gasoline feed hose connections at gasoline tank, fuel pump, and carburetor. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel. Air leaks or restrictions on suction side of fuel pump will seriously affect pump output.

4. Inspect for leaks at fuel pump diaphragm flange. To correct, tighten cover screws alternately and securely.

5. Disconnect feed pipe at carburetor. Ground distributor terminal of coil with jumper wire so that engine can be cranked without firing. Place suitable container at end of pipe and crank engine a few revolutions. If no gasoline, or only a little flows from pipe, the feed line is clogged or fuel pump is inoperative. Before condemning the fuel pump, disconnect feed lines at pump and blow through them with air hose to make sure that they are clear.

6. If gasoline flows in good volume from pipe at carburetor it may be assumed that the fuel pump and feed line are okay; however, it is advisable to make the following "static pressure" test to make certain that fuel pump is operating within specified pressure limits.

b. Fuel Pump Pressure Test

1. Disconnect gasoline pipe at carburetor and connect a suitable pressure gauge to pipe at carburetor height.

2. Start engine and check pressure with engine running at slow idle speed. If pressure is not between 4 and 6-1/2 pounds, pump should be removed for repairs (par. 3-13).

NOTE: If pressure gauge is at pump height instead of at carburetor height, the pressure should be 1/2 pound higher.

3-13 FUEL PUMP REPAIRS

There are two service kits available: 1. The diaphragm kit consisting of diaphragm, valves, and oil seal. This kit is used for overhauling low mileage pumps. 2. The repair kit consisting of all moving and wearing parts except the rocker arm. This kit is used for overhauling high mileage pumps. However, if a casting is damaged or the rocker arm is badly worn, it is advisable to replace the pump rather than attempt repairing it.

After removal of pump from engine and before disassembly is started, plug all openings and thoroughly wash exterior of pump with cleaning solvent to remove all dirt and grease.

a. Disassembly of Fuel Pump

NOTE: For instructions on the disassembly and assembly of the fuel pump on the 300 engine, see paragraph 3-13 of the Buick Special Chassis Service Manual.

1. Mark edges of fuel cover and pump body with file so that cover may be reinstalled in its original position on body. See Figure 3-23.

2. Remove all fuel cover screws and separate cover from pump body. If cover sticks to body, rap with soft mallet - do not pry between parts with a screwdriver.

3. Remove pulsator cover and diaphragm from fuel cover. Scrape out burrs produced by staking

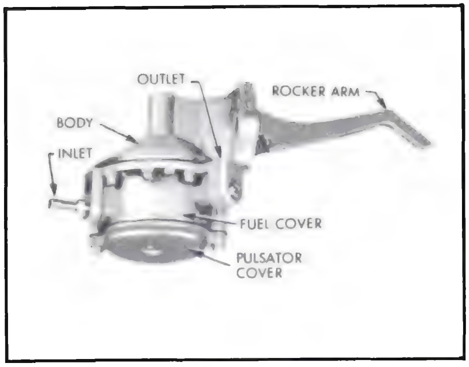


Figure 3-23—Location of Pump Parts

valves and drive both valves and gaskets from cover.

4. Block pull rod link in position farthest toward diaphragm by jamming a thin tool between link and pump body. Depress diaphragm very lightly until blocked link just touches end of slot in pull rod. Then tilt diaphragm away from body mounting flange, apply a heavy side pressure on pull rod away from mounting flange, and while still applying this pressure, tilt diaphragm toward mounting flange to unhook pull rod from link. Remove diaphragm and spring from pump body.

5. Scrape out burrs produced by staking and pry out oil seal and retainer using end of a round rod just smaller in diameter than retainer hole (3/8" rod).

b. Removal of Rocker Arm and Link

To install a diaphragm kit, it is not necessary to remove the rocker arm pin. However, when overhauling a high mileage pump, it is advisable to use the repair kit which contains a rocker arm pin and a link. Remove as follows:

1. File or grind riveted end of rocker arm pin flush with steel washer, or cut off end with a 3/8" drill. Then drive pin out with a drift punch and hammer.

2. Remove rocker arm, rocker arm spring, and link from pump body.

c. Inspection of Pump Parts

1. Clean and rinse all parts to be reused in solvent. Blow out all passages with air hose.

2. Inspect pump body and fuel cover for cracks, breakage, or distorted flanges. Examine screw holes for stripped or crossed threads.

3. Inspect rocker arm for wear at pad and at point of contact with link. Check for excessive rocker arm side-play due to wear on rocker arm pin.

4. If a damaged casting or a badly worn rocker arm is found, it is advisable to discard old parts and install a new fuel pump.

d. Assembly of Fuel Pump

When overhauling pump, always use all new parts in kit as amount of wear of these parts cannot be determined visually.

1. If rocker arm and link were removed (subpar. b above), place new rocker arm spring and link in position in pump body with rocker arm and use a slightly undersize rod through pin hole to line them up. See Figure 3-24. Drive new rocker arm pin through body, forcing lineup rod ahead of it. Install new steel washer over small end of rocker arm pin, support head of pin on a suitable steel block, and peen small end of pin to retain washer and pin in place.

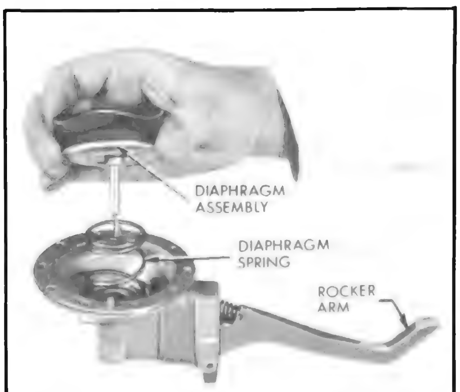


Figure 3-24—Diaphragm Assembly

2. Install new oil seal in retainer and drive retainer into body with flat end of a rod 7/8" in diameter. Stake body in four places around retainer.

3. Block link in position farthest toward diaphragm by jamming a thin tool between link and pump body. Place diaphragm spring in body, place cup shaped spring retainer on end of spring, then push diaphragm pull rod through these parts with flat of rod at 90 degrees to link in body. Hook pull rod over end of link.

4. Place a new gasket in each valve seat in fuel cover. Place valve in seat nearest "IN" connector with spring cage facing up. Place other valve in outlet valve seat with spring cage down.

5. Seat valves firmly against gaskets and stake cover in four places around edge of each valve.

6. Install new pulsator diaphragm and cover on fuel cover and tighten screws securely.

7. Place fuel cover in position so that file marks on cover and pump body are in line and install all cover screws and lock washers until screws just engage lock washers. Be sure that screws pass through holes in diaphragm without chewing fabric.

8. Tighten screws alternately and evenly until all screws are tight.

e. Testing Repaired Fuel Pump

Bench tests of the fuel pump require equipment which is not available in most service organizations; therefore, tests must be made after installation of the pump on an engine. Test the fuel pump as described in paragraph 3-12.

SECTION 3-E
ROCHESTER 2-BARREL CARBURETOR

CONTENTS OF SECTION 3-E

3-14 DESCRIPTION AND OPERATION OF ROCHESTER 2-BARREL CARBURETOR

a. General Description

The Rochester Model 2GC carburetor is of the side bowl design. While not interchangeable, the carburetors used on automatic and standard transmission cars are basically the same, and the description and service operations are identical. The only difference is in some of the internal calibrations. The carburetor float bowl is located forward of the main bores of the carburetor. The carburetor is compact in design in that all of the fuel metering is centrally located. See Figure 3-25.

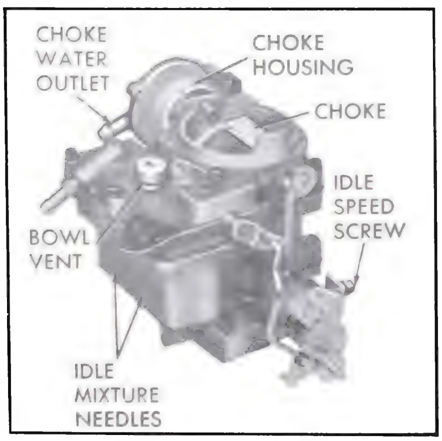


Figure 3-25—Rochester 2GC Carburetor Assembly-300 Engine

This carburetor uses a calibrated cluster design, which places in a removable assembly, the main well tubes, idle tubes, mixture passages, air bleeds and pump jets. This cluster can easily be removed for cleaning and inspection purposes. The cluster fits on a flat portion of the carburetor bowl in front of the main venturi with a gasket underneath. See Figure 3-26. The idle and main well tubes are permanently installed in the cluster body by means of a precision pressed fit and, therefore, cannot be serviced separately. The main nozzles and idle tubes are suspended in the fuel in the main wells of the float bowl.

The main metering jets are of the fixed type. Metering calibration is accomplished through a system of calibrated air bleeds which give the correct air/fuel mixtures throughout all operational ranges.

The Rochester Model 2GC carburetor employs the use of a vacuum operated power system for extra power when needed. Power mixtures are regulated by drop in engine manifold vacuum regardless of the degree of throttle opening. Thereby, additional fuel can be supplied for power mixtures according to the engine demands.

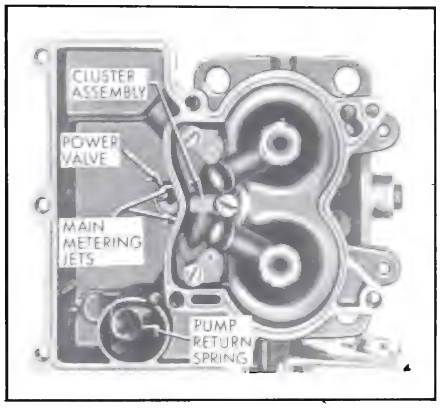


Figure 3-26—Main Body Parts

The pump system has a vented type pump plunger. This is accomplished by means of a vapor vent ball in the pump plunger head. By venting the pump plunger, any fuel vapors which form in the pump well are vented to the fuel bowl during "hot" engine operation. This insures that the pump well and passages will be primed with solid fuel at all times, thereby improving accelerator pump action.

The carburetor is internally vented through a hole in the air horn and is externally vented through a capped vent hole located in the center of the carburetor air horn just above the float bowl.

Adjustments have been made as simple as possible. They consist of idle, float level, float drop,

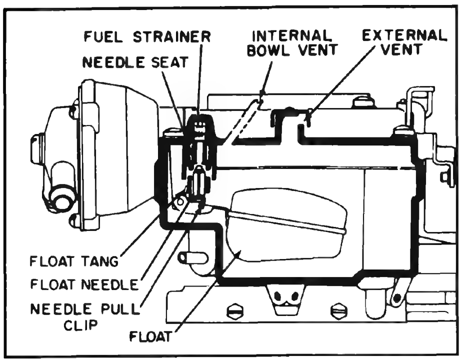


Figure 3-27—Float System

pump, fast idle, choke, choke rod and choke unloader adjustments only.

Incorporated in the Rochester Model 2GC carburetor are six basic systems. They are Float, Low Speed, Main Metering, Power, Accelerating and Choke systems. The following explanation and illustrations show that each system operates to provide efficient carburetion through all operating conditions.

b. Operation of Float System

The float system controls the level of the fuel in the carburetor fuel bowl. Fuel level is very important because it must be maintained to give proper metering through all operating ranges.

Fuel entering the carburetor must first pass through the inlet screen, by the inlet needle seat, then past the float needle, into the float bowl; flow continues until the fuel level raises the float to a position where it closes the float valve. As fuel is used from the carburetor bowl the float drops, moving the float needle off its seat and replenishing the fuel in the bowl, thereby keeping the fuel level constant. See Figure 3-27.

A float tang located at the rear of the float arm between the float hangers prevents the float assembly from moving too far downward, but allows the float assembly to move down far enough for maximum fuel flow into the carburetor bowl. A float needle pull clip connecting the float arm to the needle valve keeps the needle from sticking closed in the seat, which may be caused by dirt or gum formation.

An external vent located on the top of the carburetor air horn vents any fuel vapors which may form in the float bowl to the outside atmosphere during periods of hot engine operation. This helps prevent poor hot engine idling and hard hot engine starting.

c. Operation of Idle (Low Speed) System

During engine idle operation, air flow through the carburetor venturi is very low and is not great enough to cause fuel to flow from the main discharge nozzles. Therefore, the idle system is used to provide the proper mixture ratios required during idle

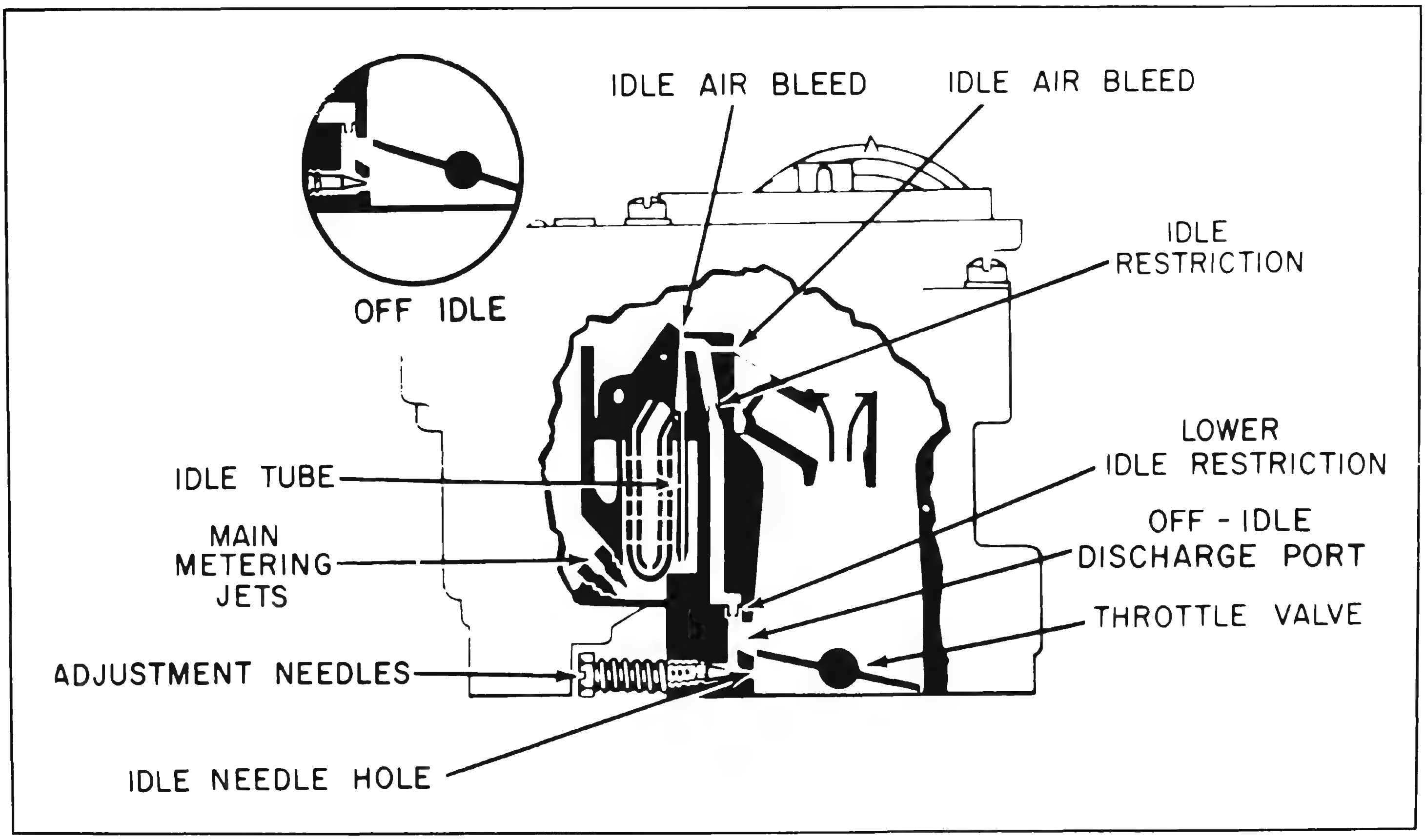


Figure 3-28—Low Speed System

and low speed operation of the engine.

The idle system consists of the idle tubes, idle passages, idle air bleeds, idle adjustment needles, off-idle discharge slots and the idle adjusting needle holes.

In idle speed position, each throttle valve is slightly open, allowing a small amount of air to pass between the wall of the carburetor bore and the edge of the throttle valve. Since there is not enough air flow for venturi action, the fuel is made to flow by the application of vacuum (low pressure) directly through the idle system to the fuel in the carburetor bowl. See Figure 3-28.

Fuel from the float bowl passes through each main metering jet into the main well where it is metered by the orifice at the lower end of the idle tube. It then passes up the idle tube and is mixed with air at the top of the idle tube by two calibrated idle air bleeds. The air/fuel mixture then passes down through a calibrated restriction into a vertical passage past a third idle bleed to the idle port located just above each closed throttle valve. Here the mixture is again bled with air and then moves down to the idle needle hole where it combines with air by-passing the slightly open throttle valve. The idle mixture needle controls the amount of fuel mixture which enters the carburetor bore at curb idle position of the throttle valve.

As the throttle valve is opened further, more and more of the idle port is exposed to manifold vacuum. This port supplies additional fuel mixture for off-idle engine requirements.

On all air conditioner equipped cars, a special thermostatic air valve is added in the hole in the rear side of the throttle body. This valve is designed to compensate for loss of engine RPM while idling under very hot operating conditions. When the underhood temperature rises beyond a certain point, the calibrated thermostatic spring opens the valve. This allows additional air to flow in below the throttle valves. At normal operating temperatures, the valve should be closed. The valve cannot be adjusted or repaired; therefore, a faulty valve must be replaced.

d. Operation of Main Metering (High Speed) System

As the throttle valve continues to open, the edge of the throttle valve is gradually moved away from the wall of the carburetor bore, reducing the vacuum so that the discharge of fuel mixture at the idle needle hole and off-idle port gradually diminishes.

With the increased throttle opening, there is increased velocity in the venturi system. This causes a drop in pressure in the large venturi which is increased many times in the small venturi. Since the low pressure (high vacuum) is now in the small venturi, fuel will flow in the following manner:

Fuel from the float bowl passes through the main metering jets into the main well and rises in the main well tubes. Air entering the main well through the main well bleeds is mixed with fuel through calibrated holes in the main well tube. The mixture then moves up and out of the discharge nozzle into a channel where more air is added. The mixture travels down through the channel to the small venturi where it is delivered to the air stream and then to the intake manifold. See Figure 3-29.

e. Operation of Power System

To achieve the proper mixtures required when more power is desired or for extreme high speed driving, a vacuum operated power piston in the air horn and a power valve located in the bottom of the float bowl are used. Through a connecting vacuum passage from the base of the carburetor to the power piston cylinder in the air horn, the power piston is exposed to manifold vacuum at all times. See Figure 3-30.

During idle and part throttle operation, the relatively high vacuum holds the power piston up against spring tension and the power valve remains closed.

Increase in engine load lowers the manifold vacuum. When it has dropped sufficiently the power piston spring overcomes the upward vacuum pull and the power piston moves downward, opening the power valve to allow additional fuel to flow through calibrated restrictions into the main well.

As the engine load decreases, the resulting higher vacuum overcomes the spring tension on the power piston and raises the power piston closing the power valve.

A 2-stage power valve is used. In the first stage, fuel is metered by the valve itself. This stage is used for light power loads. On heavy power loads the valve is fully opened to the second stage, and in this location the power valve allows the fuel to be metered by the power restrictions in the fuel channel located in the bottom of the fuel bowl.

It will be noted that the power piston cavity in the carburetor air horn is connected to the main air flow passage by a vacuum relief passage. It is the purpose of this passage to prevent the transfer of vacuum acting on the piston from acting also on the top of the fuel in the float bowl. Any leakage of air past the upper grooves of the piston will be compensated for by this relief passage and will not affect carburetor metering.

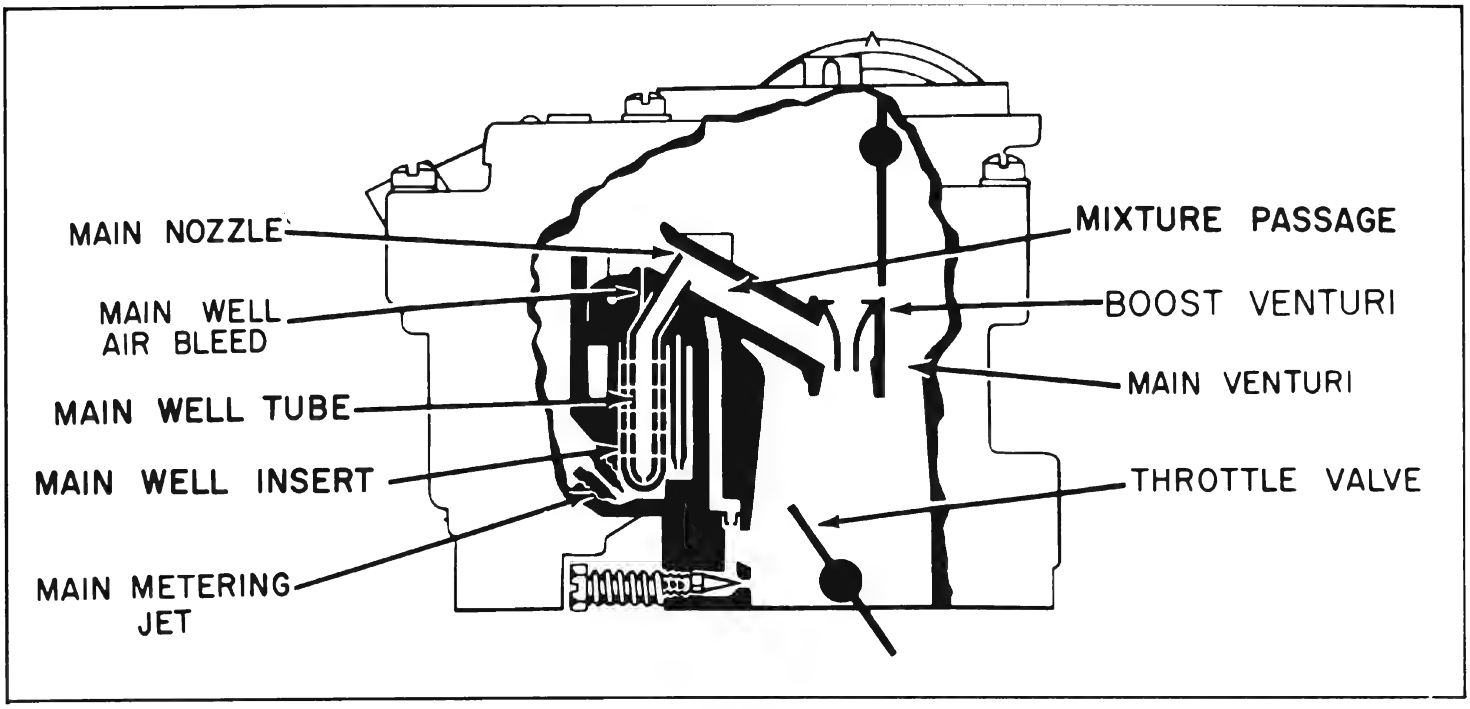


Figure 3-29—High Speed System

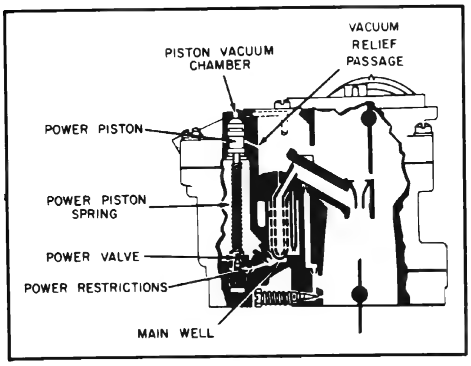


Figure 3-30—Power System

f. Operation of Accelerating System

When the throttle valve is opened rapidly, the air flow and manifold vacuum change almost instantaneously, while the heavier fuel tends to lag behind causing a momentary leanness. The accelerator pump provides the fuel necessary for smooth operation on rapid acceleration.

Fuel for acceleration is supplied by a double-spring loaded pump plunger. The top and bottom springs combine to move the plunger so that a smooth, sustained charge of fuel is delivered for acceleration.

Fuel is drawn into the pump well through the inlet ball check on the intake stroke of the pump plunger (upward stroke). See Figure 3-31.

Downward motion of the pump plunger seats the inlet ball check and forces the fuel through the discharge passage where it unseats the pump discharge ball and then passes on through to the pump jets where it sprays into the venturi.

The ball check located in the pump plunger head serves as a vapor vent for the pump well. Without this vent, vapor pressure in the pump well might force fuel from the pump system into the engine manifold causing hard starting when the engine is hot.

There is an inner hole in the pump lever to provide a richer pump adjustment for extreme cold temperature conditions. This inner hole should be used only when low temperature hesitation indicates a too lean pump setting.

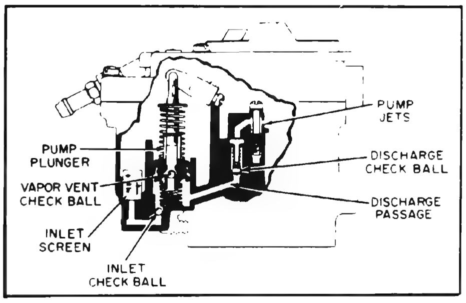


Figure 3-31—Accelerating Pump System

The pump discharge ball check in the accelerator pump passage prevents any pullover or discharge of fuel from the pump nozzles when the accelerator pump is inoperative.

g. Operation of Choke System

A new type water heated choke system is used. Instead of using hot air from the exhaust manifold to heat the choke thermostatic coil, heat from the engine hot water is used. The engine water heat is circulated directly from the engine to a chamber in the choke cover. Heat is transmitted to the thermostatic coil

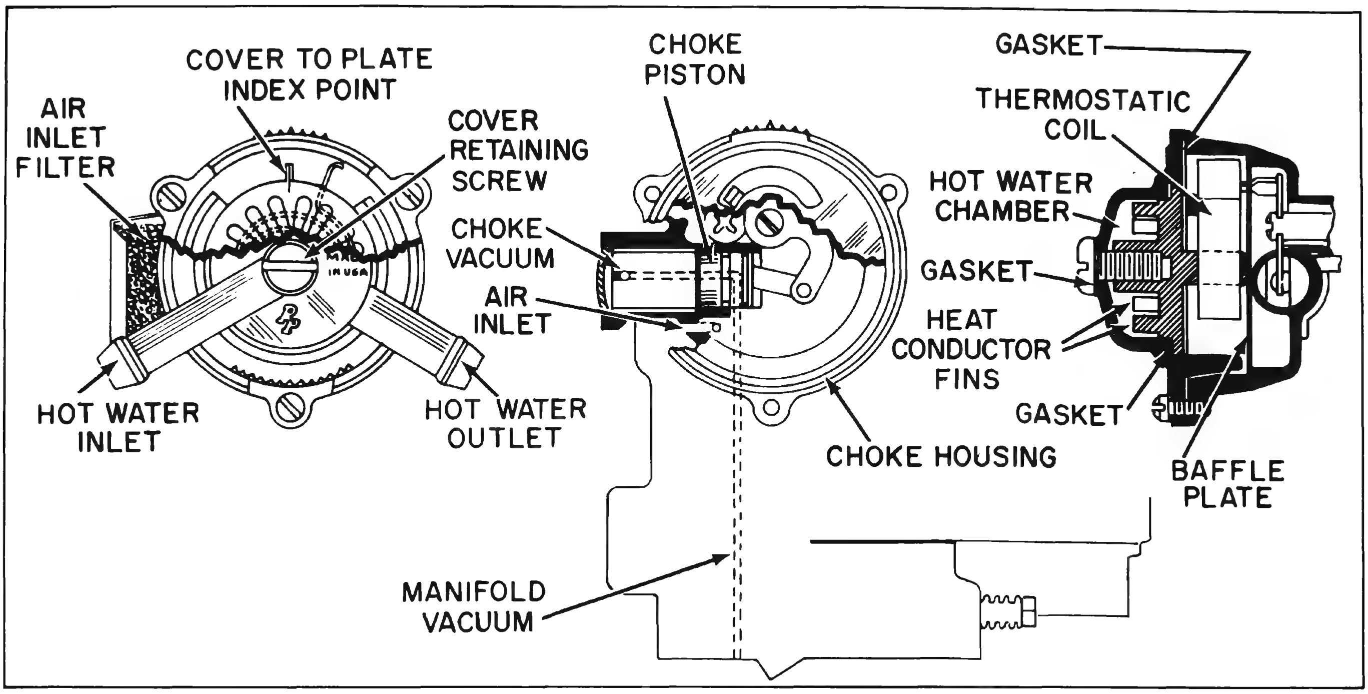


Figure 3-32—Water Heated Choke Housing

inside the choke housing by fins which project from the inner choke cover into the hot water circulating through the outer choke cover.

The choke system consists of a water heated thermostatic coil, vacuum choke piston, off set choke valve, a fast idle cam and choke linkage. Choke operation is controlled by a combination of intake manifold vacuum, the off set choke valve, atmospheric temperature and engine water temperature.

The choke thermostatic coil holds the choke valve closed when cold. When the engine is started, air velocity against the off set choke valve causes the valve to open slightly against the torque of the thermostatic coil. In addition, intake manifold vacuum applied to the choke piston through a vacuum passage, tends to open the choke valve. Vacuum pull on the choke piston is off set by the tension of the thermostatic coil.

As the engine warms up, heated water circulates through the chamber in the outer choke cover and by conduction through the inner choke cover warms the air around the thermostatic coil which begins to relax its tension on the choke valve. As the engine temperature increases, it continues to relax the thermostatic coil, which together with the vacuum pull on the choke piston and air flow against the off set choke valve, causes the choke valve to open. This action continues gradually until the engine is thoroughly warmed up, at which point the choke valve is fully opened.

Automatic choke failure due to build up of dust or other foreign material in the choke housing is prevented by a filter located at the side of the choke housing assembly. All air entering the choke housing, due to manifold vacuum drawing air into the choke housing, is filtered. Periodic service of the filter element is required to keep the air inlet open and free of foreign material.

To prevent stalling during the warm up period, it is necessary to run the engine at a slightly higher speed than for a warm engine. This is accomplished by steps on the fast idle cam. The fast idle cam is linked to the choke valve shaft by the choke rod, choke trip lever and choke lever and collar assembly. The fast idle cam holds the throttle valve open sufficiently during the warm up period to give increased idle RPM until the choke valve moves to the fully open position where normal curb idle is maintained.

A mechanical choke unloader is incorporated to open the choke valve slightly when the engine is cold or flooded. The choke unloader provides a means for opening the choke valve enough to correct any loading condition encountered during engine starting.

3-15 DISASSEMBLY, CLEANING AND INSPECTION OF THE ROCHESTER 2-BARREL CARBURETOR

a. Choke Disassembly and Removal of Air Horn

1. Mount carburetor on a proper mounting fixture such as J-5923.

2. Remove three choke cover attaching screws and retainers. Remove choke cover assembly, gasket and insulator baffle inside the choke housing.

The outer water jacket cover may be disassembled from the inner choke cover by removing the large screw and gasket in center of cover. Remove water jacket cover and gasket between inner and outer choke cover.

NOTE: The large inner to outer choke cover attaching screw should never be removed unless all coolant or water supply is drained from choke cover. Otherwise a loose screw could allow engine coolant to be drawn into the engine from leakage into the choke housing, when the engine is running.

3. The air inlet filter on the side of the choke housing may be removed by snapping off spring retaining clip.

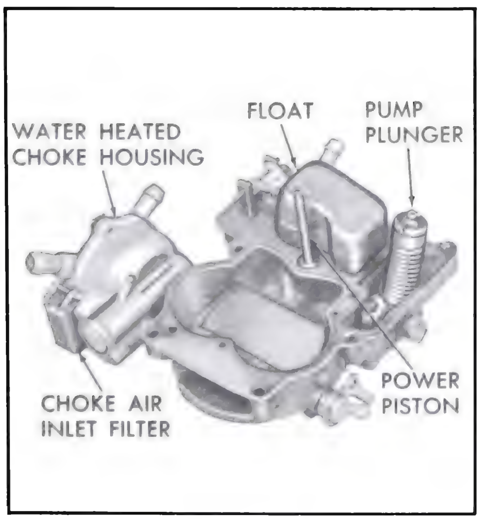


Figure 3-33—Air Horn Parts

4. Remove choke piston and lever assembly from the end of the choke shaft in the choke housing by removing retaining screw in the end of the choke shaft. Rotate choke piston lever to remove choke piston from bore in choke housing. Choke piston can now be removed from the lever by shaking piston pin into palm of hand.

5. Remove two Phillips choke housing attaching screws, then remove the choke housing and gasket from the air horn.

6. Remove pump rod by removing upper and lower retaining clips.

7. Remove fast idle cam attaching screw. Then remove fast idle cam and rod assembly by rotating until lug on upper end of choke rod passes through slot in the upper choke lever and collar assembly. The lower end of choke rod can be removed from fast idle cam in the same manner.

8. Remove air horn attaching screws and carefully remove air horn assembly from float bowl by lifting gently upward.

b. Disassembly of Air Horn

1. Place air horn assembly inverted on bench. Remove float hinge pin and lift float assembly from cover. Remove float needle from the float arm. Remove float needle seat, fibre gasket and needle seat screen. See Figure 3-33.

2. Remove power piston by depressing shaft and allowing spring to snap repeatedly, thus forcing the power piston retaining washer from casting.

NOTE: If heavy staking is encountered, remove staking from around power piston retaining washer.

3. Remove retainer on the end of pump plunger shaft, then remove pump assembly from pump inner arm. Remove pump lever and shaft assembly by loosening set screw on inner arm and removing outer lever and shaft.

4. Remove air horn gasket.

5. Remove two choke valve retaining screws, then remove choke valve from choke shaft. Remove choke shaft from air horn, then choke lever and collar assembly can be removed from choke shaft.

Note position of the choke lever in relation to the choke trip lever on the end of the choke shaft for ease in reassembly.

c. Disassembly of Float Bowl

1. Remove pump plunger return spring from pump well. Remove small aluminum check ball from the bottom of pump well by inverting bowl and shaking into hand. Remove pump inlet screen from bottom of fuel bowl.

2. Remove main metering jets.

3. Remove power valve and fibre gasket.

4. Remove three venturi cluster attaching screws and remove cluster and gasket. Center cluster screw has smooth shank and fibre gasket for the accelerator pump fuel by-pass and sealing.

5. Using a pair of long nosed pliers, remove pump discharge ball spring "T" shaped retainer. Then remove pump discharge spring and steel discharge ball.

6. Remove two main well inserts in the main well.

7. Invert carburetor and remove three throttle body to bowl attaching screws. Remove throttle body and throttle body to bowl gasket.

d. Disassembly of Throttle Body

1. Remove idle mixture adjusting needles and springs.

No further disassembly of the throttle body is needed. The throttle valves should never be removed as the idle and spark holes are drilled in direct relation to the location of the throttle valves and shaft. Removal of the throttle valves will upset this location. The throttle body assembly is only serviced as a complete unit with throttle valves intact.

e. Cleaning and Inspection

Dirt, gum, water or carbon contamination in or on the exterior moving parts of a carburetor are often responsible for unsatisfactory performance. For this reason, efficient carburetion depends upon careful cleaning and inspection while servicing.

1. Thoroughly clean carburetor castings and metal parts in carburetor cleaning solvent.

CAUTION: Pump plunger or any fiber or rubber parts should never be immersed in carburetor cleaner. Wash pump plunger in clean solvent.

2. Blow out all passages in the castings with compressed air and blow off all parts until they are dry. Make sure all jets and passages are clean. Do not use wires for cleaning fuel passages or air bleeds.

3. Check all parts for wear. If wear is noted, defective parts must be replaced. Note especially the following:

(a) Check float needle and seat for wear. If wear is noted, the assembly must be replaced.

(b) Check float hinge pin for wear and float for dents or distortion. Check float for fuel leaks by shaking.

(c) Check throttle and choke shaft bores for wear and out of round.

(d) Inspect idle mixture adjusting needles for burrs or grooves. Such a condition requires replacement.

(e) Inspect pump plunger cup; replace if damaged, worn, or hard.

(f) Inspect pump well in bowl for wear or scoring.

4. Check filter screens for dirt or lint. Clean, and if they remain plugged, replace.

5. If for any reason, parts have become loose or damaged in the cluster casting, the cluster assembly must be replaced.

6. It is recommended that new gaskets be used whenever the carburetor is disassembled or overhauled.

3-16 ASSEMBLY OF ROCHESTER 2-BARREL CARBURETOR

a. Assembly of Throttle Body

1. Screw idle mixture adjusting needles and springs into the throttle body until finger tight. Back out screw one turn as a preliminary idle adjustment.

CAUTION: Do not force idle needle against its seat or damage may result.

2. Invert float bowl assembly and place the new throttle body gasket on bowl. Install throttle body on bowl using three screws and lock washers. Tighten securely.

b. Assembly of Float Bowl

1. Drop steel pump discharge check ball into discharge hole. Install pump discharge spring and "T" shaped retainer, staking retainer in place.

NOTE: Top of retainer must be flush with flat of bowl casting.

2. Install two main well inserts. Align flat on lip of insert with flat in recess on top of main well. Install venturi cluster with gasket. Install venturi cluster screws and tighten evenly and securely. Make sure center screw is fitted with fibre gasket and special smooth shank screw is used.

3. Install two main metering jets, power valve gasket and power valve.

4. Install small aluminum inlet check ball in pump inlet in the bottom of pump well; insert pump return spring and center in well by pressing downward with finger.

5. Install pump inlet screen in the bottom of float bowl.

c. Assembly of Air Horn

1. Place new choke housing gasket in position on choke housing and install choke housing using two Phillips head attaching screws.

2. Install choke lever and collar onto choke shaft. Tang on choke lever faces away from air horn and is on top of choke trip lever.

3. Install choke shaft and lever assembly into the air horn. Choke rod hole in the choke lever faces fuel inlet side of carburetor.

4. Install choke valve in choke shaft so that letters "RP" will face upward in finished carburetor. Install two new choke valve attaching screws but do not tighten securely until choke valve is centered. Center choke valve on choke shaft by holding choke valve tightly closed; then slide choke shaft in to obtain approximately .020 clearance between choke trip lever and choke lever and collar assembly. Tighten choke valve screws securely and stake lightly in place. Choke valve will be perfectly free in all positions when installed correctly.

5. Install outer pump lever and shaft assembly into air horn with lever pointing toward choke shaft. Install inner pump arm with plunger hole inward and tighten set screw securely.

6. Attach pump plunger assembly to the inner pump arm with pump shaft off set pointing inward and install retainer.

7. Install needle seat screen on the needle seat and assemble float needle seat and gasket in air horn. Tighten needle seat securely, using a wide bladed screwdriver.

8. Install power piston into vacuum cavity. Lightly stake piston retainer washer in place. Piston should travel freely in cavity.

9. Install air horn gasket on air horn, fitting gasket over guide pin.

10. Attach float needle to float. Carefully position float and insert float hinge pin. Drop tang on rear of float arm should point downward toward air horn.

11. Fuel inlet fitting should be installed if removed.

12. Float level adjustment.

With air horn assembly inverted, measure the distance from the air horn gasket to lower edge (sharp edge) of float seam at end of float, using the 1/2 inch float level gauge, as shown. Bend float arm as required to adjust float level. See Figure 3-34.

13. Float drop adjustment.

With air horn assembly held upright, measure distance from gasket to bottom of float pontoon at outer end, using 1-29/32 inch float drop gauge for scale, as shown. Bend float tang as required to adjust float drop, as shown in Figure 3-35.

14. Carefully place air horn assembly on float bowl, making certain that the pump plunger is properly positioned in the pump well. Lower the cover gently, straight down, then install air horn to float bowl attaching screws. Tighten evenly and securely.

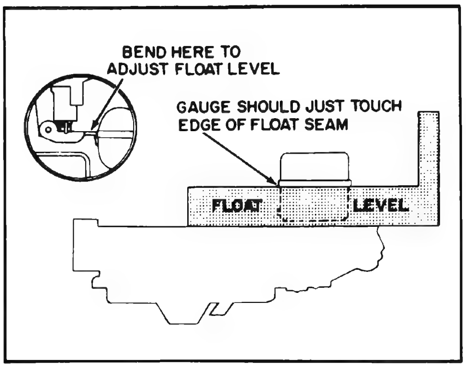


Figure 3-34—Float Level Adjustment

NOTE: <u>Longer air horn screw goes in top of pump housing.</u>

15. Install choke rod into choke lever and fast idle cam. Install fast idle cam screw and tighten securely. See Figure 3-36 for proper installation.

16. Install accelerator pump rod in outer hole and into throttle lever and install retainers.

17. Assemble choke piston to the choke lever and link assembly, retaining with piston pin. Piston pin hole in side of choke piston faces toward air horn. Install choke piston into the choke housing bore and attach choke piston lever to the end of the choke shaft, making sure flats on lever line up with flats on choke shaft. Install retaining screw and tighten securely.

18. Install insulator baffle into choke housing.

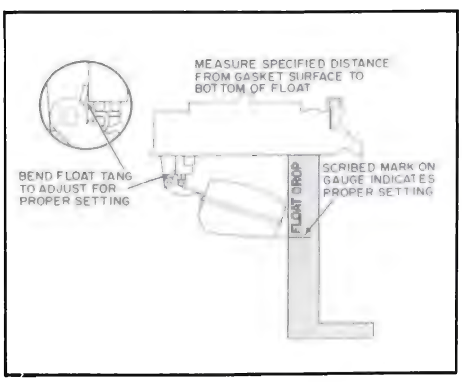


Figure 3-35—Float Drop Adjustment

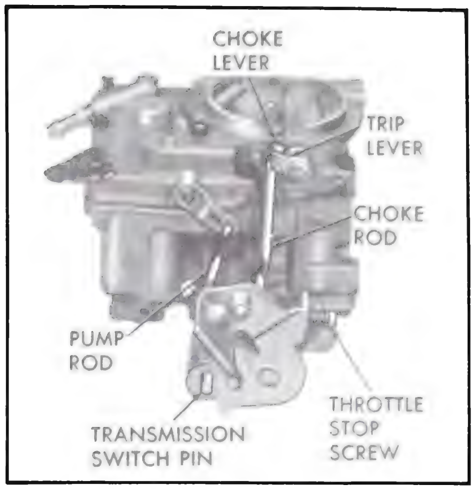


Figure 3-36—Choke Linkage

d. Assembly of Water Heated Choke

1. Assemble inner choke cover to outer cover by first placing a new gasket on the flat surface on outer cover. Then, install inner cover to outer cover, using large retaining screw and gasket.

2. Before tightening the large outer to inner cover retaining screw, align index marks inside cover to the index mark on the outer cover. Then tighten the large screw securely. This is very important for proper choke indexing. See Figure 3-37.

3. Install new gasket on hot water choke cover assembly; then install assembly to choke housing rotating counterclockwise until the thermostatic coil picks up the choke piston lever and closes the choke valve. Rotate cover until index mark on cover aligns with the index mark on choke housing on synchromesh transmission cars, or 2 notches rich on automatic transmission cars.

4. Install three choke cover retaining screws and retainers and tighten securely. With the index markings aligned, the choke valve should be lightly closed at 75°F.

3-17 EXTERNAL ADJUSTMENT OF ROCHESTER 2-BARREL CARBURETOR

All adjustments on the carburetor, except for float adjustments, are made externally. For float level and drop adjustments, see Steps 12 and 13.

a. Pump Rod Adjustment

Back out idle stop screw and completely close throttle valve in bore. Place pump gauge across top of carburetor air horn ring, as shown, with 1-11/32 inch leg of gauge pointing downwards towards top of pump rod. Lower edge of gauge leg should just touch the top of the pump rod. Bend the pump rod as required to obtain the proper setting using Tool J-4552. See Figure 3-38.

b. Choke Rod Adjustment

Turn idle stop screw into the normal idle position (normal idle position would be with the idle stop screw turned in approximately one turn against the fast idle cam, with the choke valve held wide open). Place idle stop screw on the second step of the fast idle cam against shoulder of the high step. Wire gauge marked .040 should just go between the upper edge of choke valve and wall of air horn. Bend tang on choke lever to obtain correct choke rod setting. See Figure 3-39.

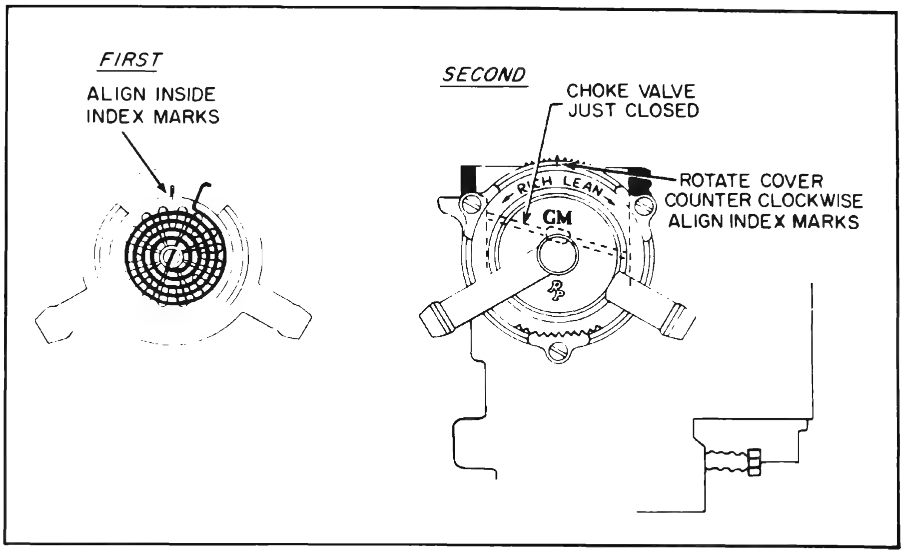


Figure 3-37—Choke Coil Adjustment

c. Choke Unloader Adjustment

With throttle valves held wide open, choke valve should be opened enough to admit end of gauge marked .085 between upper edge of choke valve and inner air horn wall. Bend unloader tang on throttle lever to obtain proper clearance. See Figure 3-40.

d. Slow Idle Adjustment

Adjust slow idle in drive to 500 RPM (add 50 RPM for air conditioner). When engine is at normal operating temperature, adjust idle mixture needle screws; re-adjust idle speed if necessary. See paragraph 3-8.

e. Fast Idle Adjustment

A fast idle speed adjustment is not required because fast idle is controlled by the throttle stop screw. If the idle speed is correctly set and the choke rod properly adjusted, the fast idle will be maintained.

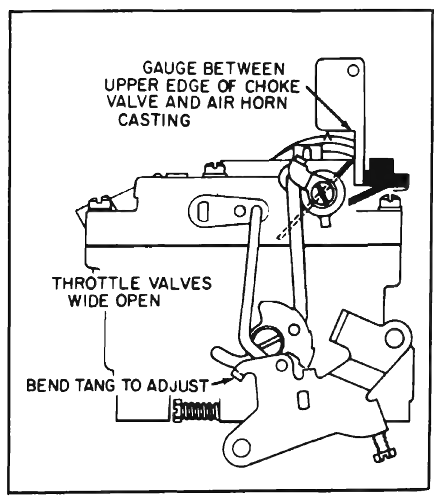


Figure 3-40—Choke Unloader Adjustment

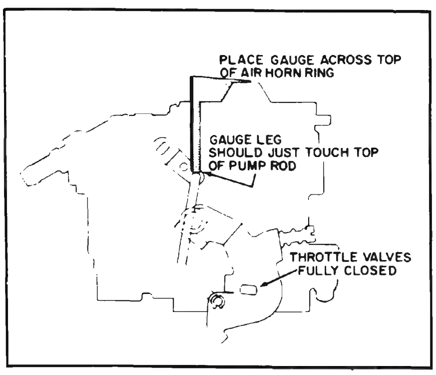


Figure 3-38—Pump Rod Adjustment

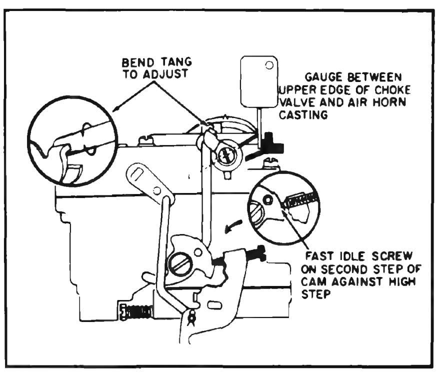


Figure 3-39—Choke Rod Adjustment

SECTION 3-F

ROCHESTER 4-BARREL CARBURETOR

CONTENTS OF SECTION 3-F

3-18 DESCRIPTION AND OPERATION OF ROCHESTER 4-BARREL CARBURETOR

a. General Description

The Rochester Model 4GC is a 4-barrel down-draft type which provides the advantages of a compound installation of two 2-barrel carburetors in one compact unit. See Figure 3-41 or 42. To aid description and the proper identification of parts the carburetor is considered to be divided into a primary section and a secondary section.

The primary section covers the 2-barrelled forward half of the carburetor assembly. This section is essentially a complete 2-barrel carburetor containing a float system, idle system with adjustable needle valves, main metering system, power system, and accelerating system. This section also includes the automatic choke mechanism.

The secondary section covers the 2-barrelled rearward half of the carburetor assembly. This section is essentially a supplementary 2-barrel carburetor which cuts in to assist the primary section when a predetermined throttle opening and engine RPM are reached. This section contains a float system, a non-adjustable idle system, and a main metering system. It has a separate set of throttle valves and a set of auxiliary valves, which are located in the barrels above the throttle valves.

The primary throttle valves are operated by the accelerator pedal and the connecting throttle linkage. The secondary throttle valves are operated by the primary throttle valve shaft through delayed action linkage which permits a predetermined opening of the primary valves before the secondary valves start to open. Action of the linkage then causes both sets of throttle valves to reach the wide open position at the same time.

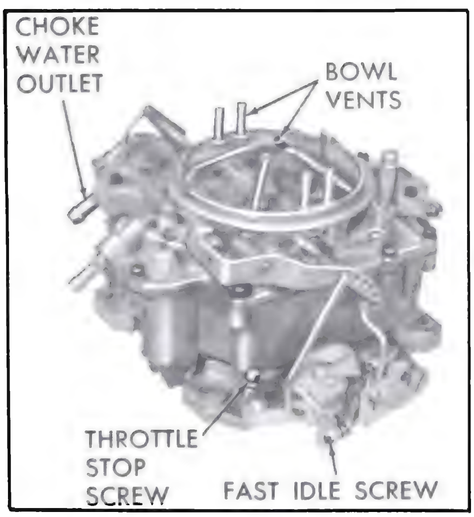


Figure 3-41—Rochester 4-Barrel Carburetor-300 Engine

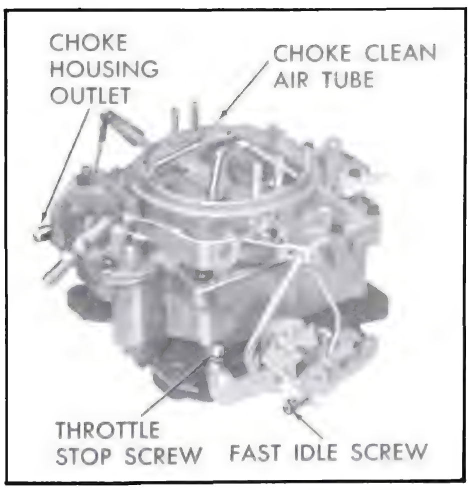


Figure 3-42—Rochester 4-Barrel Carburetor-401 Engine

b. Operation of Float System

Each section of the carburetor has a separate and independent float system, consisting of a float chamber formed by a partition in the main body, a 2-pontoon float, a needle valve seat and valve. Fuel enters the carburetor through the inlet port in the primary side of the air horn. From this point fuel flows to the separate float chambers through a horizontal passage in the air horn. There is a fuel strainer located just above each needle seat on both the primary and secondary side. See Figure 3-43.

When the fuel reaches the prescribed level in each float chamber the float moves the needle valve against its seat to shut off the flow of fuel. The needle valves are connected to the float levers by clips. Because of these, the needle valves will be pulled from their seats if stickiness is encountered due to gum formation.

The floats are spring loaded at the rear tangs. The purpose of these balance springs is to give a more positive closing of the needle valves. The spring tension against the tangs determines float drop and also helps determine fuel level. See Figure 3-43.

There is a cored passage located in the side of the carburetor body which links the fuel chambers on the primary and secondary sides together. In this way, any abnormal rise in fuel in one side of the carburetor bowl will automatically balance with the other side.

The joint between the air horn and the main body is sealed by a gasket, and the float chambers are vented by passages which are calibrated to provide proper air pressure above the fuel under all operating conditions. These passages in the air horn lead into the throat of the air horn, and to outside atmosphere. The amount of fuel metered by the carburetor depends on the air pressure on the fuel in the float bowl. The external vents permit fumes to escape from the float chambers when the engine is idling or stopped after extremely hot operation.

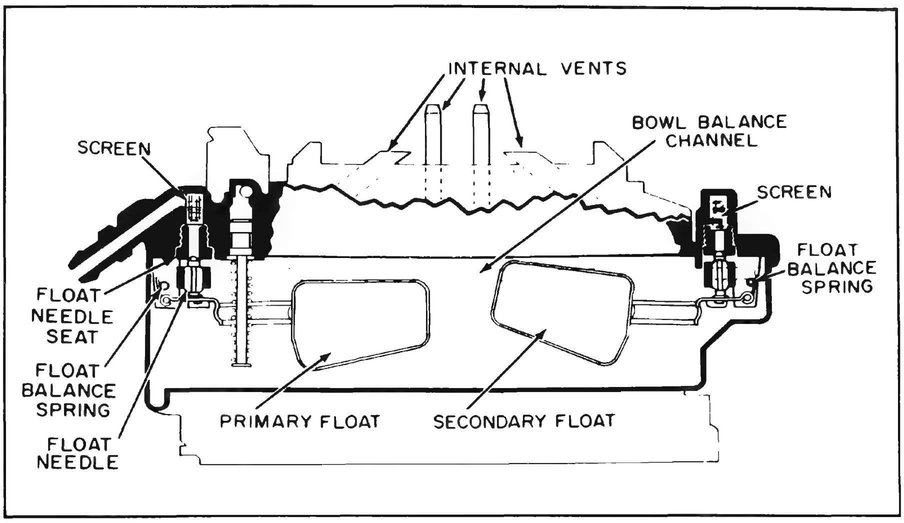


Figure 3-43—Primary and Secondary Float Systems

c. Operation of Idle (Low Speed) Systems

Each barrel of the carburetor has a separate idle system but the general operation is identical in all barrels. The idle system in each barrel supplies fuel to the engine whenever the position of the throttle valve is such that suction is created at the idle discharge holes in the throttle body.

Suction on an idle discharge hole causes fuel in the float chamber to flow through the main metering jet and upward into the idle tube which meters the fuel. Calibrated bleed holes permit air to enter at the top and side of the idle passage in the cluster so that a mixture of fuel and air passes down the idle channel to the idle discharge holes. Additional air is drawn into the fuel-air mixture in the idle channel through lower idle air bleeds which are in the primary side of the main body. See Figure 3-44.

When the throttle valve is closed, the fuel-air mixture is supplied through the lower idle discharge holes only, since the upper holes are above the valve and are not affected by suction. As the throttle valve is opened, suction is also placed on the upper idle discharge holes which then feed additional fuel-air mixture into the engine. With continued opening of the throttle valve the suction on the idle discharge holes tapers off until a point is reached where the idle system no longer supplies fuel-air mixture. Before

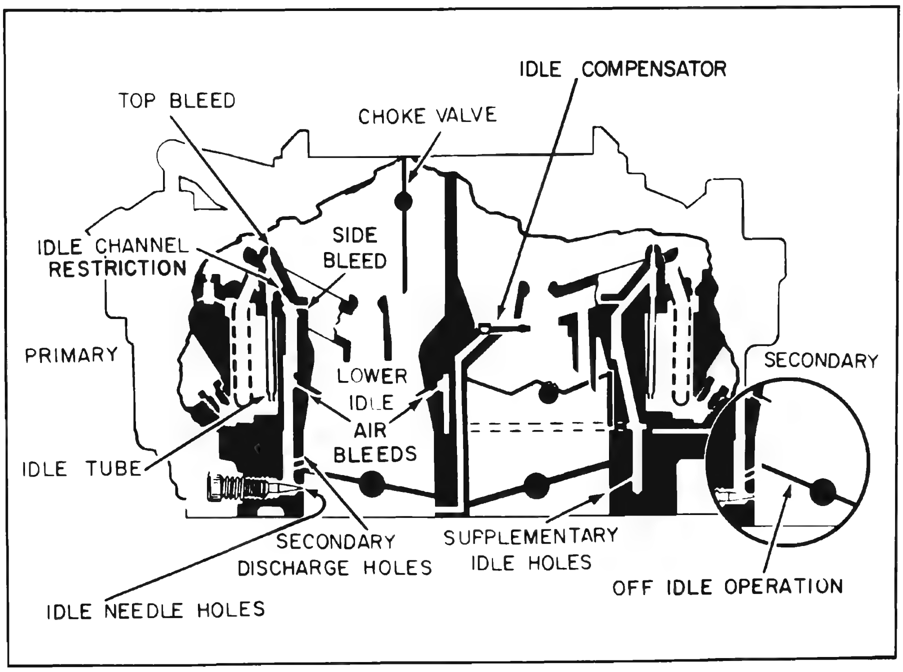


Figure 3-44—Primary and Secondary Idle Systems

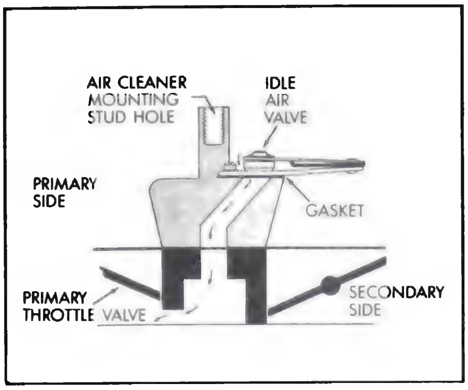


Figure 3-45—Idle Compensator

this point is reached however, the main metering system has begun to supply fuel, as described later.

The lower idle air bleeds discharge fuel after the idle systems cease to operate, thereby keeping fuel immediately available in the idle channels at a point very near the idle discharge holes and also enriching the mixture being delivered by the main metering system.

In the primary section, the quantity of fuel-air mixture supplied through the lower idle discharge holes is controlled by the idle needles, which may be adjusted to provide smooth engine idle operation. In the secondary section, the quantity of idle fuel-air mixture is controlled by the fixed size of discharge holes located in the rear of the secondary throttle bores.

On the secondary side of the float bowl, a thermostatic valve allows additional air to enter the primary bores under extreme hot idle conditions. This valve, called the "idle compensator", is operated by a bi-metal strip which senses temperature. See Figure 3-45. In a prolonged hot idle the bi-metal strip bends, raising the valve and uncovering a hole leading to the underside of the primary throttle valves. The additional air drawn into the engine in this manner is sufficient to offset the enrichening effects of high temperatures and prevent hot idle stalling. When underhood temperatures are lowered, the valve closes and operation returns to normal. This valve cannot be repaired, so a defective valve must be replaced.

d. Operation of Main Metering Systems

Each barrel of the carburetor has a separate main metering system; however, the operation of all systems is identical. The main metering system in each barrel supplies fuel to the engine whenever the position of the throttle valve is such that the incoming air stream creates suction on the main discharge nozzle.

Air entering the barrel through the air horn passes through the venturi tubes which increases the velocity of the air and create a suction on the main discharge nozzle. This causes fuel to flow from the float chamber through the main metering jet into the main discharge nozzle. Air is drawn in through the high speed bleeder so that a mixture of fuel and air is discharged from the main discharge nozzle into the air stream passing through the small venturi in the barrel of the carburetor. See Figure 3-46.

The main metering systems in the primary section control the flow of fuel during the intermediate or part throttle range of operation and up to approximately 85 MPH if the car is accelerated gradually. The secondary throttle valves remain closed until the primary valves have opened approximately 45-55 degrees, after which they are opened proportionately so that all valves reach the wide open position at the same time. While the secondary throttle valves are closed, the auxiliary valves located above them are held closed by the spring tension on the auxiliary valve shaft; therefore, there is not sufficient air flow through the barrels to operate the main metering system in the secondary section.

When the secondary throttle valves are open and engine speed is about 1600 RPM, the resulting air flow through the secondary barrels starts to open the auxiliary valves because their supporting shaft is located off-center in the barrels. The auxiliary valves will be fully open at approximately 2800 RPM. When the auxiliary valves are open the main metering systems in the secondary section also supply fuel to the engine. See Figure 3-46.

During the period in which the secondary throttle valves are open and air flow is not high enough in the secondary bores to open the auxiliary valves, additional fuel is needed for the air which by-passes around the auxiliary valves. This additional fuel is supplied by tubes which extend from the mixture channel in the venturi cluster arm to the low pressure point below the closed auxiliary valves. The tubes are slashed on the bottom to provide a smoother transition between the opening of the secondary valves and the opening of the auxiliary valves. When the air flow is high enough to open the auxiliary valves, the down tubes no longer feed the fuel because the low pressure point is now in the small venturi. With this feature the correct fuel-air mixture is supplied at any point during secondary throttle valve operation.

e. Operation of Power System

For maximum power under load or for all speeds above approximately 85 MPH, a richer mixture is required than that necessary for normal throttle opening. This additional fuel is provided by one power system connected to the main metering systems in the primary section of the carburetor. See Figure 3-46.

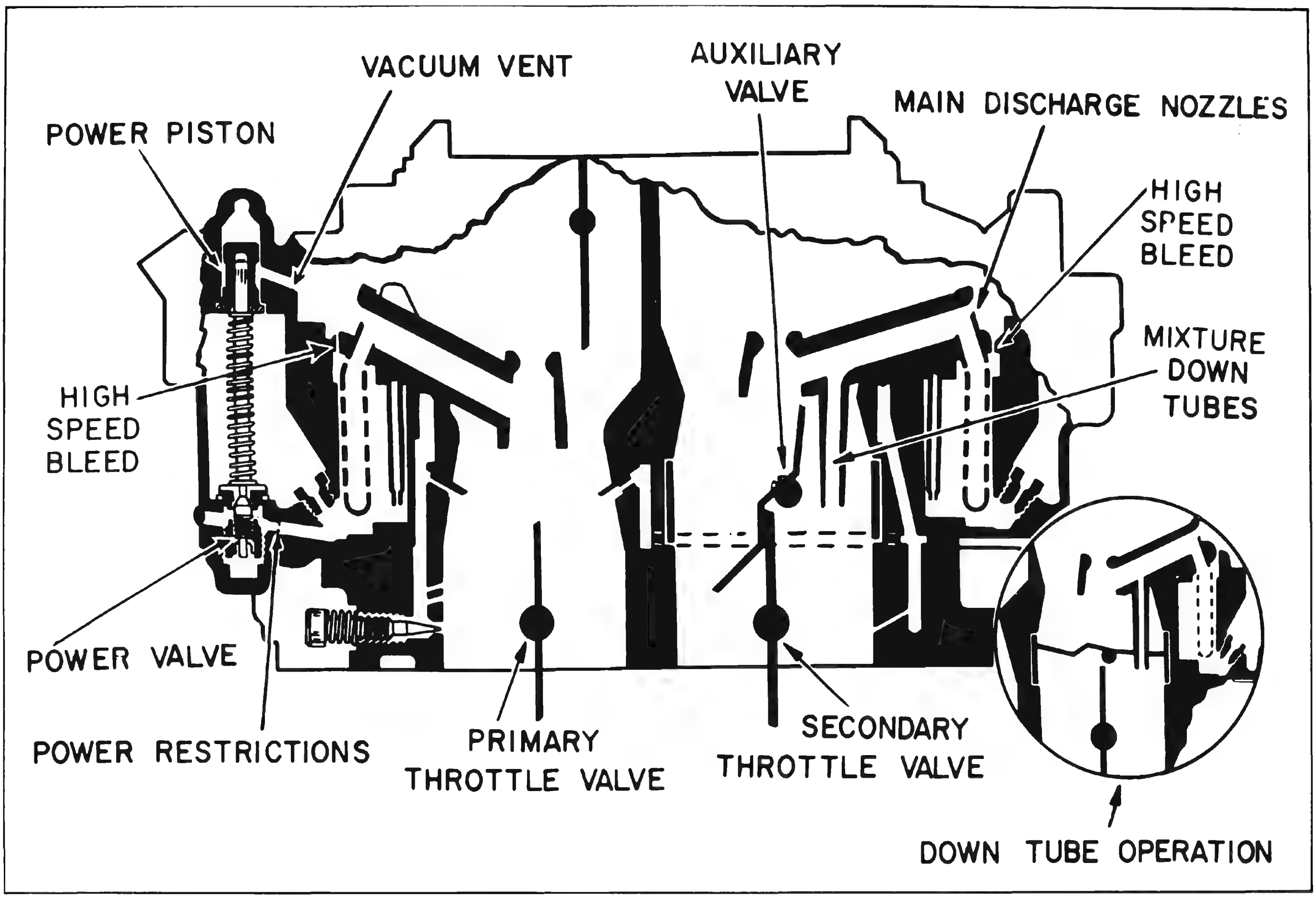


Figure 3-46—Main Metering and Power Systems

The power piston cylinder in the air horn of the carburetor is connected by a channel to the face of the mounting flange so it is subject to intake manifold vacuum. At part throttle position the vacuum is sufficient to hold the power piston in its "up" position against the tension of the piston spring. When the throttle valves are opened to a point where manifold vacuum drops to approximately 9 to 5 inches of mercury and additional fuel is required for satisfactory operation, the piston spring moves the power piston down to open the power valve. This allows additional fuel to enter the main discharge nozzles in the primary section through calibrated restrictions located below the main metering jets. See Figure 3-46.

f. Operation of Accelerating System

For smooth and rapid acceleration it is necessary to supply an extra quantity of fuel momentarily when the throttle is opened suddenly. This is accomplished by one accelerating pump piston which is directly connected to the primary throttle shaft lever by means of a rod and pump lever.

When the throttle is closed, the pump piston moves up and draws a supply of fuel from the float chamber through the inlet strainer, past the inlet ball check valve and into the pump cylinder. When the throttle is opened, the piston on its downward stroke exerts pressure on the fuel which closes the inlet check ball and opens the outlet check ball. A metered quantity of fuel is then discharged through the pump discharge nozzles into each barrel in the primary section of the carburetor. This occurs only momentarily during the accelerating period. The pump duration spring which

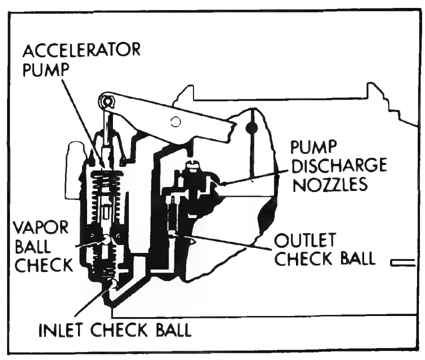


Figure 3-47—Accelerating System

is compressed by the downward movement of the pump linkage against the resistance of the fuel provides a follow-up action so that the discharge carries out over a brief period of time. A ball check in the accelerator pump plunger acts as a vapor vent to prevent vapor pressure from forcing fuel from the pump discharge holes during extreme heat periods. Downward movement of the plunger, however, seats the ball and allows normal operation of the accelerating system. See Figure 3-47.

When the desired speed is reached and the throttle is held in a fixed position, the pressure on the fuel decreases sufficiently so that the outlet check ball closes and fuel ceases to discharge from pump nozzles. Thus a quantity of fuel is maintained in the channel adjacent to the outlet check ball where it is immediately available for future requirements.

g. Operation of Choke System

In 401 and 425 engines, the automatic choke mechanism is contained in the primary section of the carburetor. It consists of a choke valve mounted on a shaft in the carburetor air horn connected through linkage to a thermostat mounted on the carburetor throttle body. The thermostat contains a bi-metal spring and a vacuum actuated piston. A choke rod connects the choke valve to a fast idle cam on the throttle body. A heat pipe connects the choke housing to a heat stove in the right exhaust manifold.

The heat stove in the exhaust manifold heats the air which is drawn through it and the heat pipe into the choke housing. A restriction in the choke housing cover regulates the quantity of air flowing into the choke housing to heat the thermostat.

When the accelerator pedal is depressed preparatory to starting the engine, the throttle stop screw is lifted clear of the fast idle cam and the thermostat then closes the choke valve. When the engine starts, intake manifold vacuum causes the piston to partially open the choke valve against the spring tension of the thermostat, thereby admitting sufficient air to give a satisfactory running mixture.

If the throttle is partially opened while the running engine is cold, the increased force of air flow against the off-set choke valve will open the valve against the spring tension of the thermostat. At the same time the choke valve opens, the fast idle cam will also drop to a new position, thereby reducing the fast idle speed when the throttle is again closed.

As the engine and exhaust manifold warm up, warm air is drawn through the heat pipe into the choke housing by manifold vacuum. This warms the thermostat, causing it to reduce its spring tension on the choke valve in proportion to the increase in temperature. This, in turn, allows the choke valve to be opened by the combined forces of air velocity on the valve and vacuum on the choke piston.

When the engine reaches normal operating temperature, the choke thermostat is heated to the point where it no longer exerts any spring tension on the choke valve. The choke valve is in the wide open position and the fast idle cam is in the slow idle position so that the fast idle screw misses

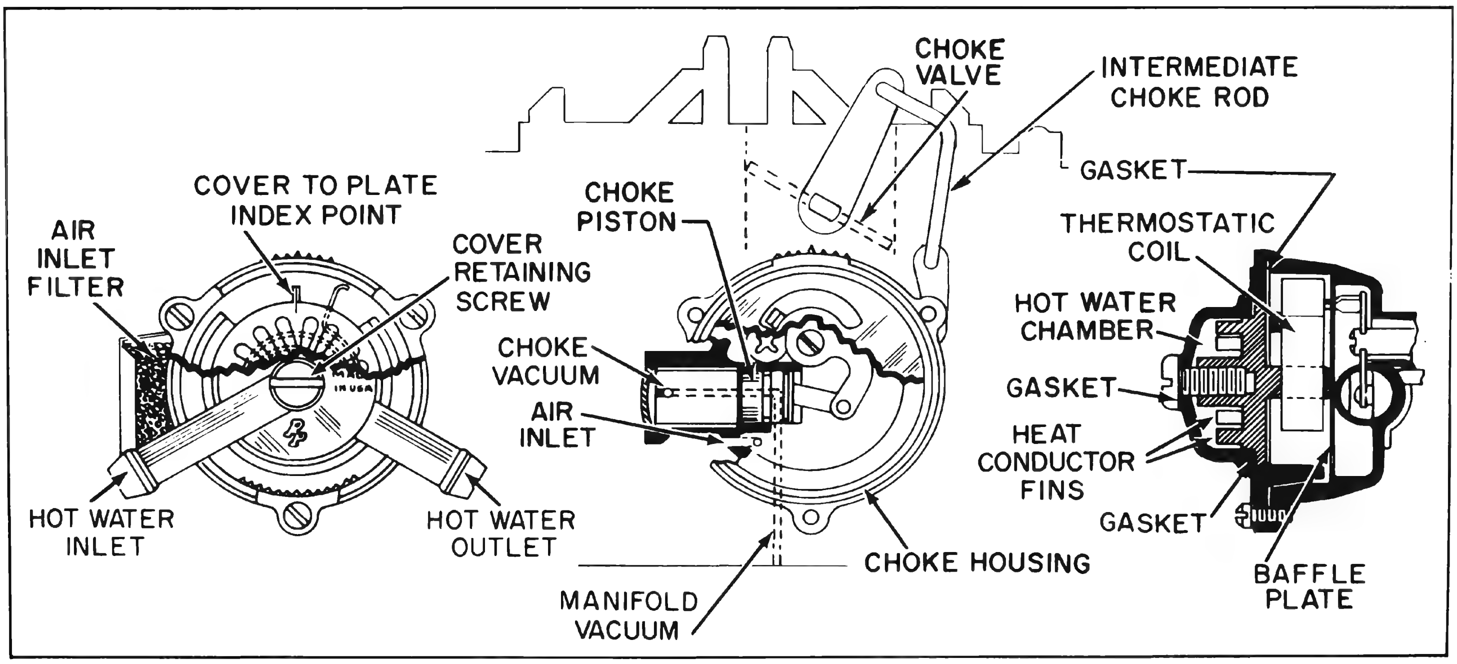


Figure 3-48—Water Heated Choke Housing-300 Engine

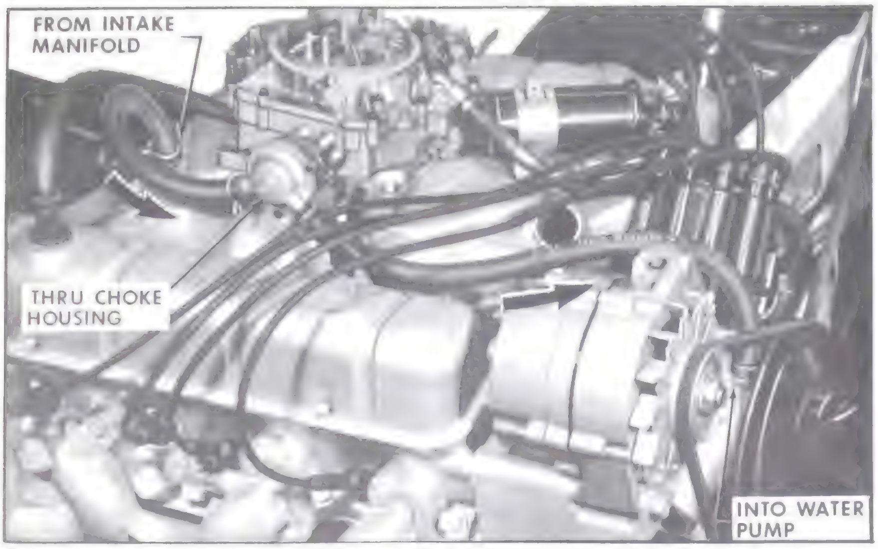


Figure 3-49—Water Heated Choke System-300 Engine

the cam completely. The throttle stop screw now takes over in determining curb idle speed.

In 300 engines, a hot water heated choke system is used. Instead of using hot air from the exhaust manifold to heat the choke thermostatic coil, heat from the engine hot water is used. The engine water is circulated directly from the engine to a chamber in the choke cover. Heat is transmitted to the thermostatic coil inside the choke housing by fins which project from the inner choke cover into the hot water circulating through the choke cover. See Figures 3-48 and 49.

Automatic choke failure due to build up of dust or other foreign material in the choke housing is prevented by a filter located at the side of the choke housing assembly. All air entering the choke housing, due to manifold vacuum drawing air into the choke housing, is filtered. Periodic service of the filter element is required to keep the air inlet open and free of foreign material.

h. Operation of Choke Unloader

If the engine becomes flooded for any reason, the choke valve can be partially opened by depressing the accelerator pedal to the full extent of its travel. This causes an arm on the throttle lever to contact and rotate the fast idle cam, which forces the choke valve open.

i. Operation of Secondary Lock-Out

The secondary section does not have a choke valve in the air horn. In order to prevent air from entering the carburetor through the secondary side during the engine warm-up period it is necessary to block the movement of the secondary throttle valves by means of the lock-out slot in the fast idle cam.

When the choke valve is in any position except wide open, it holds the fast idle cam up from its lowest position. This causes a lock-out slot in the fast idle cam to engage a tang on the secondary throttle shaft lever which prevents the secondary throttle valves from opening.

When the choke is wide open the lock-out slot of the fast idle cam drops to its lowest position; the secondary throttle shaft tang is then free to move and the secondary valves can open.

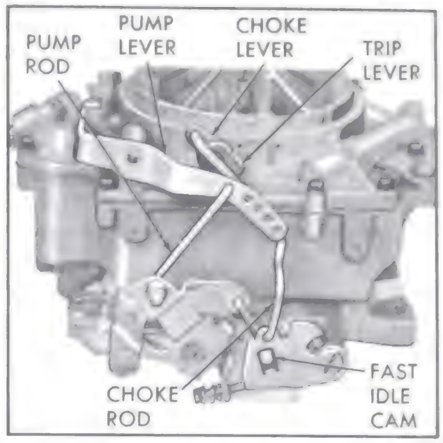


Figure 3-50—Exterior Linkage-300 Engine

3-19 DISASSEMBLY, CLEANING, AND INSPECTION OF ROCHESTER 4-BARREL CARBURETOR

1. Remove spring clip from upper end of intermediate choke rod and disengage rod from choke shaft lever. See Figure 3-50.

2. Remove clip from upper end of pump rod and disengage rod from pump lever. Remove horseshoe clip from upper end of pump plunger.

3. Remove choke trip lever and attaching screw. Disengage choke lever and collar assembly from choke shaft and disengage lower end of choke rod from fast idle cam. Then remove choke lever and collar, and choke rod as an assembly. See Figure 3-50.

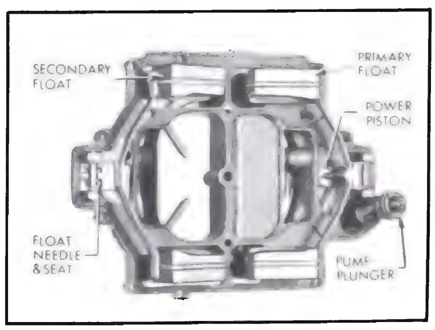


Figure 3-51—Air Horn Parts

4. Remove two choke valve attaching screws. Remove choke valve from slot in shaft. Remove burrs from choke shaft, then remove shaft from air horn.

5. Remove all air horn screws, then carefully lift air horn straight up from main body to avoid damaging floats, pump plunger, and vacuum power piston which are attached to air horn. See Figure 3-51.

6. Remove float hinge pin, float and needle from primary side being careful not to damage small spring. Then remove inlet needle seat and gasket. Remove fuel inlet strainer. NOTE: Keep primary float system parts separate from secondary float system parts.

7. Remove float hinge pin, float needle, needle seat, and gasket from side opposite pump (secondary). Then remove needle seat strainer. See Figure 3-51.

8. Remove pump plunger assembly and boot from air horn. Remove air horn gasket.

9. Remove power piston assembly by compressing spring and letting it snap repeatedly until hammering action of power piston drives staked retaining disk from air horn. NOTE: It may be necessary to remove burrs if heavy staking is encountered.

10. Remove thermostat cover screws and retainers. Remove thermostat cover assembly and gasket. Remove choke baffle plate. Remove choke piston lever screw and take choke piston, piston pin, connecting link, and lever from thermostat housing as an assembly.

11. In a 300 engine carburetor, remove three choke cover attaching screws and retainers. Remove choke cover assembly, gasket and insulator baffle inside choke housing. The outer water jacket cover may be disassembled from inner choke cover by removing large screw and metal gasket in center of cover; then remove outer water jacket cover and gasket between inner and outer cover.

NOTE: The large inner to outer choke cover screw should never be loosened unless all coolant is drained from the choke housing. A loose screw could allow coolant to leak into the choke housing and on into the engine.

The air inlet filter on the side of the choke housing can be removed by snapping off spring retaining clip.

12. Remove screws holding thermostat housing to throttle body. Remove thermostat housing and gasket. Then remove intermediate choke shaft, lever, and rod from choke housing as an assembly.

13. Remove attaching screws from cluster assembly on pump side of carburetor (primary). Then carefully remove cluster assembly and gasket. NOTE: Keep primary main body parts separate from secondary main body parts as they are all different.

14. Remove both main metering jets from pump side of main body. See Figure 3-52. Remove power valve and gasket.

15. Remove pump return spring from pump plunger well. Remove outlet check ball spring guide from outlet hole. Carefully invert carburetor main body and catch aluminum pump inlet check ball and larger steel pump outlet ball in hand.

16. If necessary, remove pump inlet screen and retainer from bottom of float bowl. NOTE: If screen is not visibly damaged or plugged, it need not be removed.

17. Remove secondary cluster assembly screws, cluster assembly, and gasket. Remove both secondary main metering jets.

18. Remove idle compensator and gasket from secondary side by removing two self-tapping screws.

Be careful not to bend or distort valve holder strip or bi-metal strip.

19. Invert carburetor. Remove idle mixture adjusting needles and springs. Remove vacuum hose fitting.

20. Remove throttle body to main body screws. Asbestos plug and retainer must be removed to gain access to one screw. Remove throttle body and gasket.

21. Remove auxiliary throttle body assembly by lifting straight up from inverted bowl. CAUTION: This auxiliary throttle assembly should not be disassembled because it is calibrated at the factory.

22. The throttle body assembly consisting of the body, primary and secondary throttle valves, shafts, levers, and springs is serviced only by replacing the assembly. Therefore the throttle body should not be disassembled further for normal cleaning and inspection.

3-20 ASSEMBLY AND INTERNAL ADJUSTMENT OF ROCHESTER 4-BARREL CARBURETOR

When assembling the carburetor, use all new gaskets and any additional new parts found to be necessary during inspection. Calibrated parts must be as specified for carburetor CODE number.

1. With main body inverted on bench, place auxiliary throttle body assembly in its proper position with screw heads toward top of carburetor. Check to make sure it is flush or slightly below main body casting.

2. Place new gasket on main body and install throttle body assembly and screws.

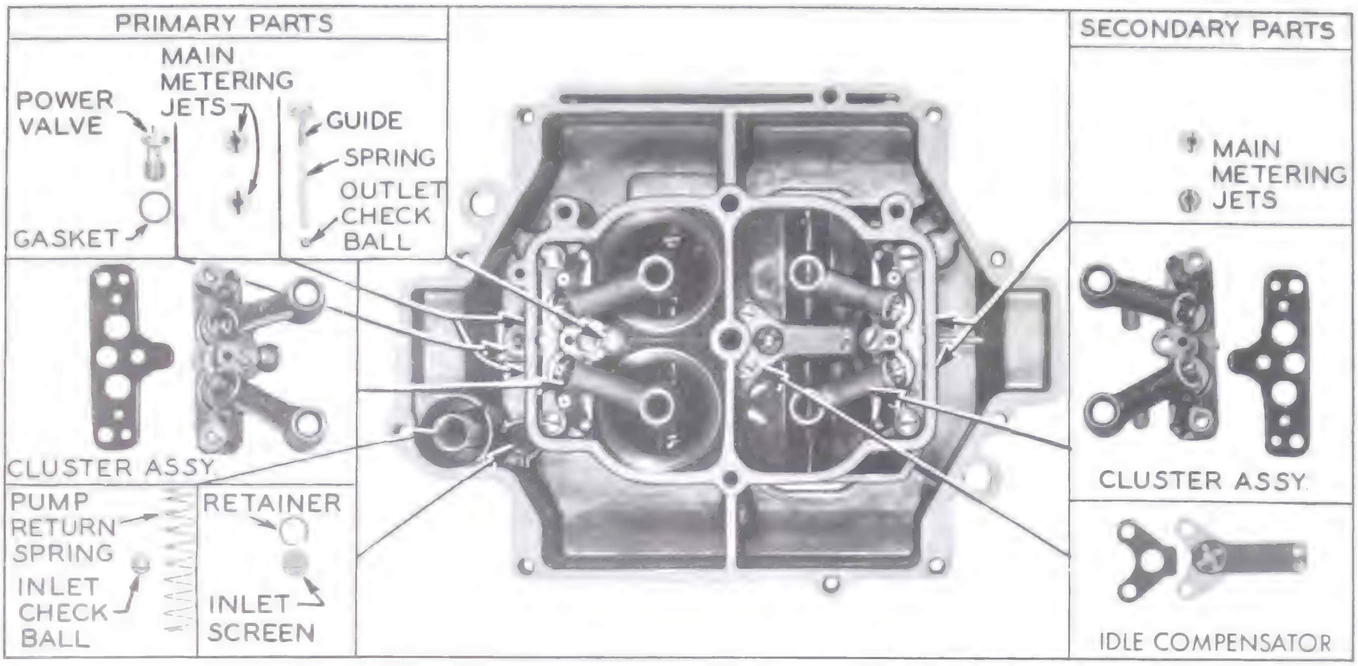


Figure 3-52—Main Body Parts

3. If removed, install throttle stop screw and fast idle screw with springs (throttle stop screw has a round point; fast idle screw has a flat point). Install vacuum hose fitting. Install both idle mixture needles and their springs. Seat needles lightly and back out 1-1/2 turns which will provide an average starting adjustment. Forcing needles hard against seats will score them and ruin them for service.

4. Place throttle body and main body assembly in upright position on bench or mounting fixture.

5. Install idle compensator using a new gasket. Install secondary cluster assembly using a new gasket. This cluster has no pump discharge nozzles.

6. Install all four main metering jets. These jets have tapered seats and do not require gaskets.

NOTE: The primary jets are the two having the smaller holes and are installed in the pump side of the body.

7. Install pump outlet check ball. This is a steel ball and is larger than the pump inlet ball. Install pump outlet ball spring and spring guide.

8. Install primary cluster assembly, screws, lock washers, and new gasket in pump side of carburetor.

9. Install new pump inlet screen and retainer if old screen was removed.

10. Install pump inlet check ball (small aluminum) and pump return spring. NOTE: Never substitute a steel ball for the aluminum ball.

11. Install power valve and gasket.

12. Assemble choke piston and pin to choke piston lever and connecting link, makine sure that pin hole in piston is opposite from tang on lever. Then install in thermostat housing. Install intermediate choke shaft, lever, and rod assembly in choke housing with lever hanging down. Connect choke piston lever to intermediate choke shaft with screw. Do not use lubricant of any kind on piston or in cylinder.

13. Install thermostat housing on throttle body using a new gasket.

14. Install pump plunger assembly and boot in inverted air horn. Install power piston assembly and stake securely in air horn. Power piston must be free in any position.

15. Install new air horn gasket. Install a fuel inlet strainer on inlet side of each needle seat. Install float needle seats and gaskets. Install float needles, floats, and hinge pins making sure that float tangs are placed outside balance springs. NOTE: All primary and secondary float system parts should go back in their same positions, thereby holding need for float adjustments to a minimum. The float needles are also matched to their respective seats and should never be mixed.

16. Adjust Primary Float Level. Make all float adjustments with gasket in place.

(a) With air horn inverted, position part of primary gauge marked "HEEL" vertically at highest

Figure 3-53—Primary Float Heel Adjustment

part of each float pontoon. See Figure 3-53. Adjust as necessary.

(b) Position part of primary gauge marked "TOE" vertically at dimple in each pontoon as shown in Figure 3-55. Adjust as necessary.

17. <u>Adjust Secondary Float Level.</u>

(a) With air horn inverted, position part of secondary gauge marked "HEEL" vertically at highest part of each float pontoon. See Figure 3-54. Adjust as necessary.

(b) Position part of secondary gauge marked "TOE" vertically at dimple in each pontoon. See Figure 3-55. Adjust as necessary.

Figure 3-54—Secondary Float Heel Adjustment

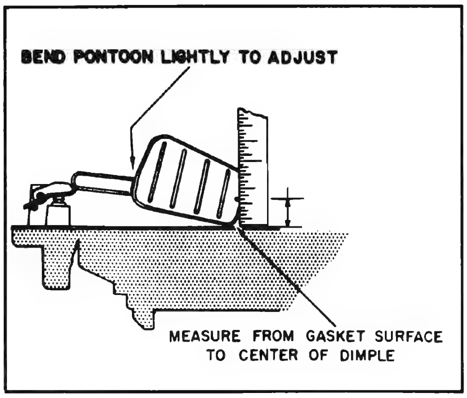


Figure 3-55—Secondary Float Toe Adjustment

18. <u>Align Floats.</u> Align bowl cover gasket with screw holes in cover. Then make sure all float pontoons are centered in and aligned with the gasket cut-outs. See Figure 3-56.

19. <u>Adjust Float Drop.</u> Float drop must be adjusted accurately because it affects float balance spring tension which, in turn, affects fuel level in the bowl.

(a) Hold air horn upright and level, gasket in place and floats hanging freely. Bounce floats lightly to make sure they are in normal settled position.

(b) Position part of primary gauge marked "DROP" vertically from air horn gasket to dimple in each primary pontoon. See Figure 3-57.

(c) Position part of secondary gauge marked "DROP" vertically from air horn gasket to dimple in each secondary pontoon. See Figure 3-58.

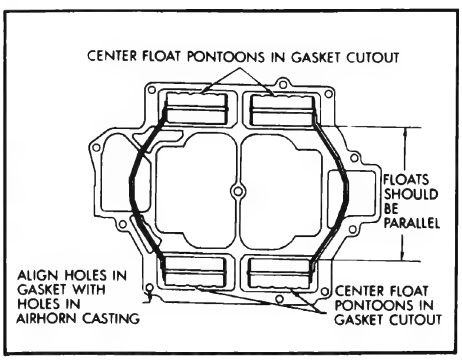


Figure 3-56—Float Alignment

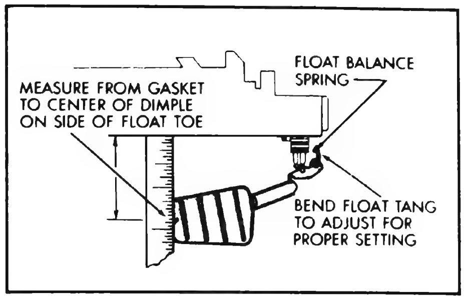


Figure 3-57—Primary Float Drop Adjustment

(d) If adjustment is necessary, bend float arm tang toward balance spring to decrease float drop, or away from balance spring to increase float drop.

20. If <u>any</u> float setting is changed, always recheck all other adjustments and alignment of that float.

21. Install air horn assembly on main body, using care to avoid distortion of float assemblies and making certain that pump piston cup does not have any creases or curled edges when it is inserted in cylinder. Install 13 air horn screws. Tighten three inner screws first for better sealing.

22. Install choke shaft and lever. Install choke valve with "RP" up and install screws loosely. Align choke valve by working choke shaft endwise while maintaining an upward pressure on choke shaft lever. Tighten and stake choke valve screws. Check for uniform clearance and freedom from sticking, as improper fit or binding may cause hard starting.

23. Install choke rod, and choke lever and collar assembly. Install

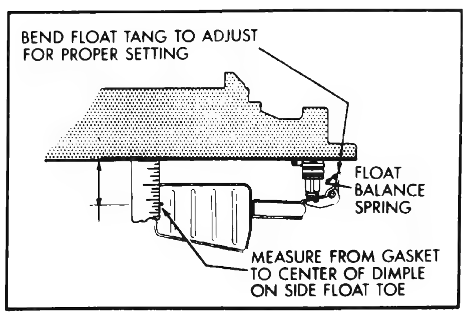


Figure 3-58—Secondary Float Drop Adjustment

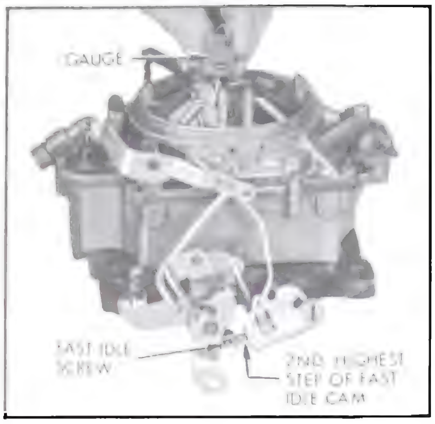


Figure 3-59—Checking Fast Idle Cam Adjustment

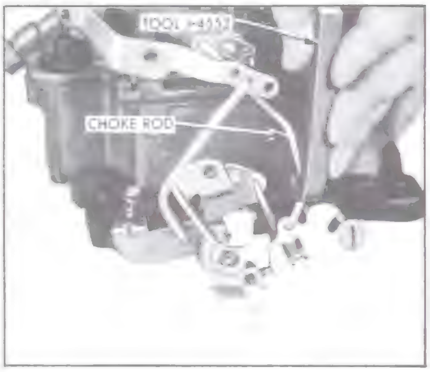


Figure 3-60—Adjusting Fast Idle Cam

choke trip lever on end of choke shaft with "RP" out and tighten attaching screw. See Figure 3-50.

24. Install clip on upper end of pump plunger. Install accelerator pump rod in pump lever. Install clip on upper end of pump rod.

3-21 EXTERNAL ADJUSTMENT OF ROCHESTER 4-BARREL CARBURETOR

1. Fast Idle Cam Adjustment. Close throttle so that fast idle screw contacts second highest step of fast idle cam with side of screw against rise to high step of cam, then check clearance between choke valve and air horn dividing wall using .050" gauge (300 engine) or .030" gauge (401 engine). See Figure 3-59.

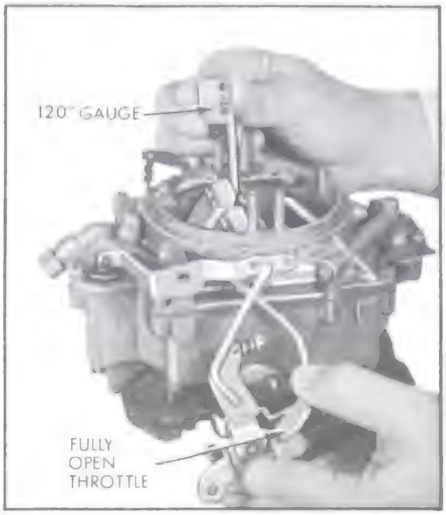


Figure 3-61—Checking Choke Unloader Adjustment

2. If choke valve clearance is not correct, bend choke rod as required to obtain this clearance using Tool J-4552. See Figure 3-60.

3. Choke Unloader Adjustment. Fully open throttle so that throttle arm contacts unloader tang on fast idle cam, then check clearance between choke valve and air horn dividing wall using .120" gauge. See Figure 3-50.

4. If choke valve clearance is not correct, bend unloader tang as required to obtain specified clearance using Tool J-5197. See Figure 3-62.

5. Secondary Lock-Out Adjustment. Close choke valve so that secondary throttle lock-out tang is on lock-out step of fast idle cam. Check clearance between tang and step using .015" gauge. See Figure 3-63.

6. If clearance between tang and lock-out step is not correct, bend tang as required to obtain this clearance using Tool J-6058A. See Figure 3-64.

7. Secondary Contour Adjustment. Fully open choke valve so that

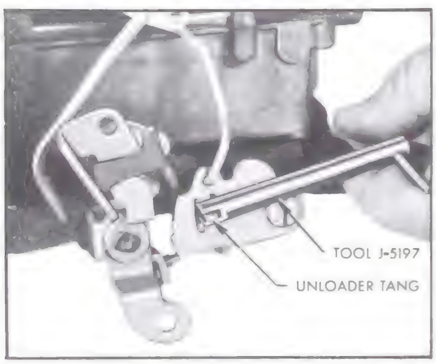


Figure 3-62—Adjusting Choke Unloader

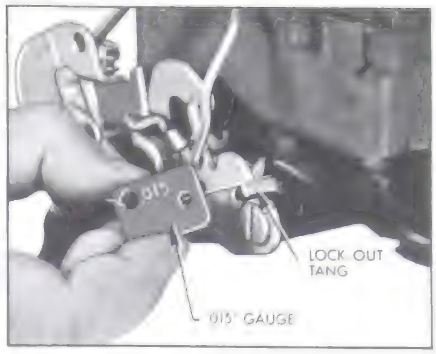


Figure 3-63—Checking Secondary Lock-Out Adjustment

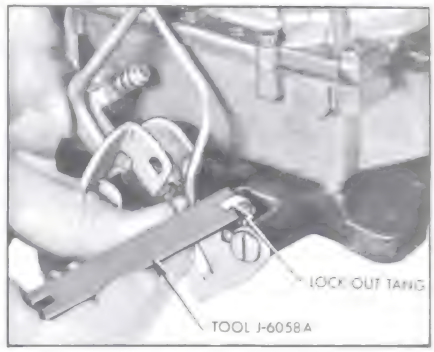


Figure 3-64—Adjusting Secondary Lock-Out

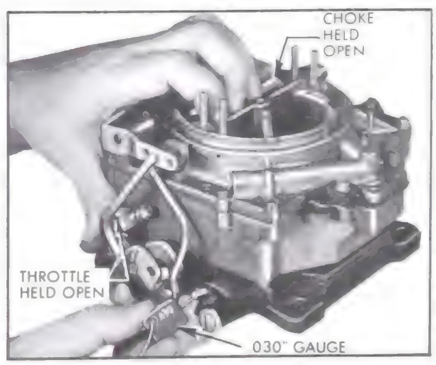


Figure 3-65—Checking Secondary Contour Adjustment

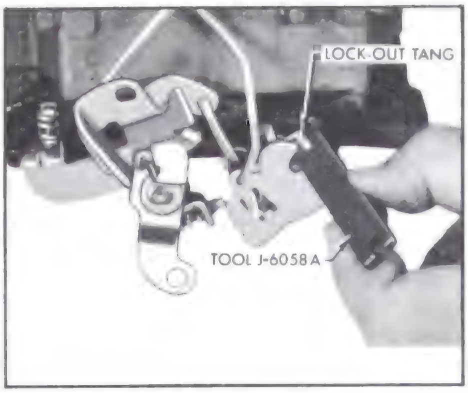


Figure 3-66—Adjusting Secondary Contour

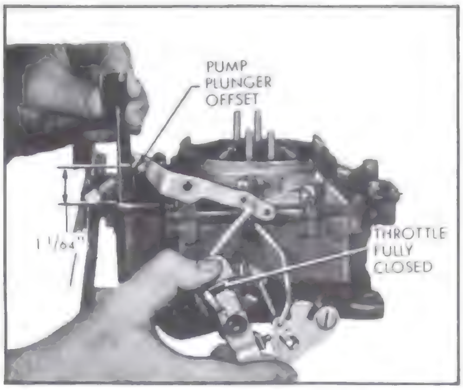


Figure 3-67—Checking Pump Plunger Adjustment

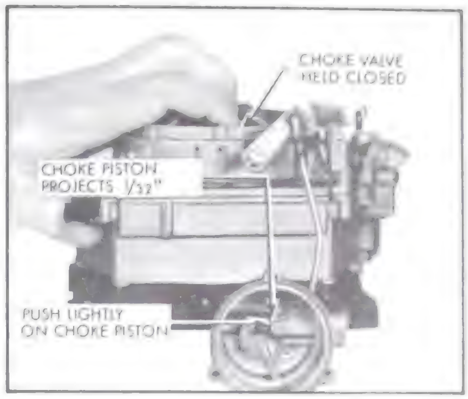


Figure 3-68—Checking Choke Piston Adjustment

fast idle cam falls to its lowest position. Then open throttle so that secondary lock-out tang follows contour portion of fast idle cam. With choke held wide open, check clearance between lock-out tang and contour portion of cam using .030" gauge. See Figure 3-65.

8. If clearance between tang and contour is not correct, bend tang as required to obtain this clearance using Tool J-6058A. See Figure 3-66.

9. If adjustment was necessary to correct lock-out tang to contour clearance, the tang to lock-out slot clearance should be rechecked (Steps 5 & 6) to be sure it was not disturbed.

10. Pump Plunger Adjustment. Push fast idle cam to full down position and back out throttle stop screw until primary throttle valves can be fully closed. With throttle held closed and pump rod in center hole of lever, measure vertically from under side of pump plunger offset to air horn casting. See Figure 3-67. Measurement should be 1-1/64" on 401 engine carburetors or 7/8" in the center (No. 3) hole on 300 engine carburetors. After adjusting, pump rod must be moved to the inner (No. 1) hole on synchromesh transmission cars.

11. Turn throttle stop screw in (from fully closed throttle position) one turn which will provide an initial slow idle speed adjustment. Install intermediate choke rod and spring clip.

12. Choke Piston Adjustment. With choke valve held tightly closed, and with choke piston pushed lightly toward its cylinder (to take up any linkage slack), check to see that choke piston is projecting from cylinder 1/32". See Figure 3-68. If adjustment is required, bend intermediate choke rod using Tool J-5197. See Figure 3-69.

13. Choke mechanism must be absolutely free in any position; mechanism is free if choke will fall open from its own weight. Install choke baffle plate. Install choke cover and gasket. Rotate counterclockwise until index marks align and choke valve is just closed, then tighten screws and retainers. See paragraph 3-8.

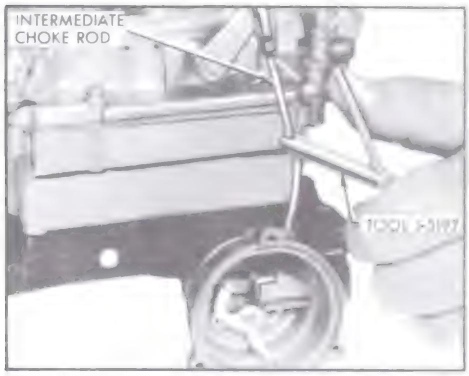


Figure 3-69—Adjusting Choke Piston

14. Assembly of Hot Water Choke.

a. Assemble inner choke cover to outer cover by first placing a new gasket on the flat surface on outer cover. Then, install inner cover to outer cover, using large retaining screw and gasket.

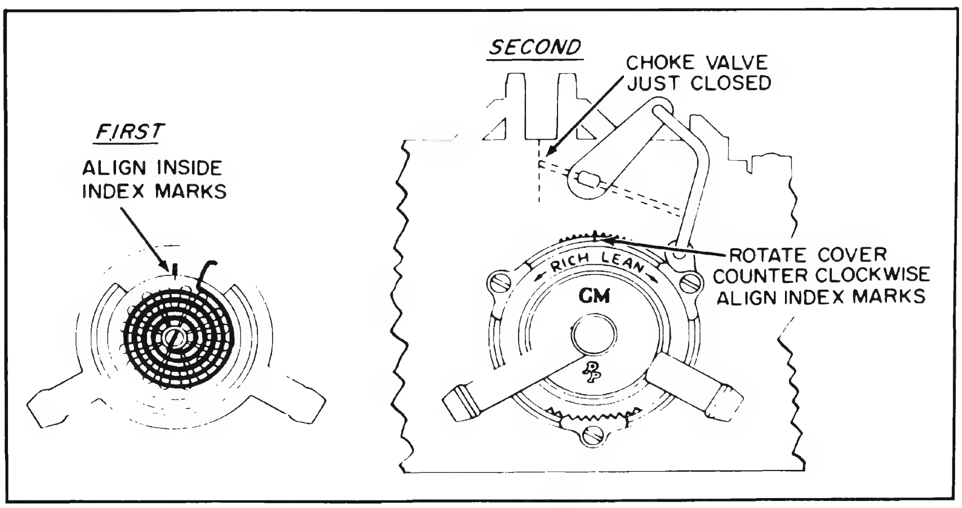


Figure 3-70—Choke Coil Adjustment-300 Engine

b. Before tightening the large outer to inner cover retaining screw, align index marks inside inner cover to the index mark on the outer cover. Then tighten the large screw securely. This is very important for proper choke indexing. See Figure 3-70.

c. Install new gasket on hot water choke cover assembly; then install assembly to choke housing rotating counterclockwise until the thermostatic coil picks up the choke piston lever and closes the choke valve. Rotate cover until index mark on cover aligns with the index mark on choke housing.

d. Install three choke cover retaining screws and retainers and tighten securely. With the index markings aligned, the choke valve should be lightly closed at 75°F.

15. Fast Idle Speed Adjustment. Make fast idle speed adjustment on car with engine at normal operating temperature and transmission in drive. Set fast idle screw on lowest step of fast idle cam and adjust fast idle screw until engine speed is 600 RPM.

SECTION 3-G
CARTER 4-BARREL CARBURETOR

CONTENTS OF SECTION 3-G

3-22 DESCRIPTION AND OPERATION OF CARTER 4-BARREL CARBURETOR

a. General Description

The Carter Model AFB carburetor is a 4-barrel downdraft type which provides the advantages of a compound installation of two 2-barrel carburetors in one compact unit. See Figure 3-71. See paragraph 3-1 (c) for the specifications of this carburetor.

The primary section covers the 2-barrelled forward half of the carburetor assembly. This section is essentially a complete 2-barrel carburetor containing a low speed system, high speed system, power system and accelerating system. This section also includes the automatic choke mechanism.

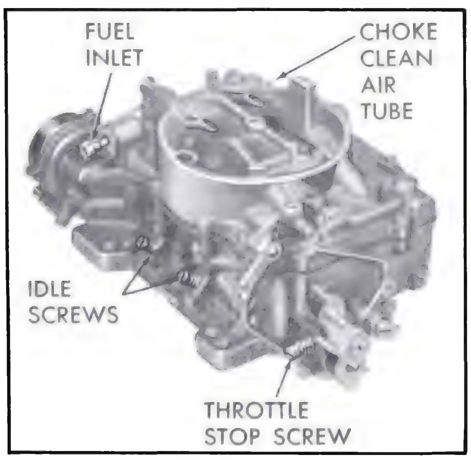


Figure 3-71—Carter AFB Carburetor Assembly

The secondary section covers the 2-barrelled rearward half of the carburetor assembly. This section is essentially a supplementary 2-barrel carburetor which cuts in to assist the primary section when a predetermined car speed or engine load is reached. This section contains its own high speed system. It has a separate set of throttle valves and a set of auxiliary valves which are located in the barrels above the throttle valves.

The primary throttle valves are operated by the accelerator pedal and the connecting throttle linkage. The secondary throttle valves are operated by the primary throttle valve shaft through delayed action linkage which permits a predetermined opening of the primary valves before the secondary valves start to open. Action of the linkage then causes both sets of throttle valves to reach the wide open position at the same time.

b. Operation of Float Systems

The purpose of the float system is to maintain an adequate supply of fuel at the proper level in the bowl for use by the low-speed, high-speed, pump and choke circuits.

There are two separate float circuits. Each float circuit supplies fuel to a primary low-speed circuit and a primary and secondary high-speed circuit. See Figure 3-72.

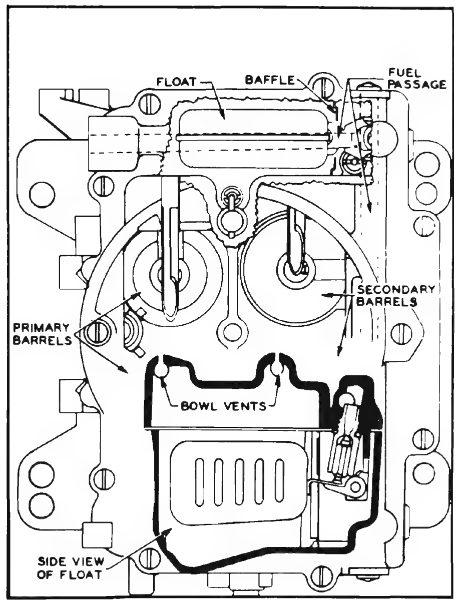


Figure 3-72—Float Circuits

Setting the floats to specifications assures an adequate supply of fuel in the bowls for all operating conditions. Special consideration should be given to be sure the floats do not bind in their hinge pin brackets or drag against inner walls of bowl.

The intake needle seats are installed at an angle to provide the best possible seating action of the intake needles.

Intake needles and seats are carefully matched during manufacture. Do not use the left needle in the right seat or vice versa. To avoid unnecessary bending, both floats should be reinstalled. in their original positions and then adjusted.

The bowls are vented to the inside of the air horn and also to atmosphere. A connecting vent passage in the air horn effects a balance of the air pressure between the two bowls. Bowl vents are calibrated to provide proper air pressure above the fuel at all times.

c. Operation of Low Speed Systems

Fuel for idle and early part throttle operation is metered through the low speed system. The low speed system is located on the primary side only. See Figure 3-73.

Gasoline enters the idle wells through the main metering jets. The low speed jets measure the amount of fuel for idle and early part throttle operation. The air by-pass passage economizers and idle air bleeds are carefully calibrated and serve to break up the liquid fuel and mix it with air as it moves through the passages to the idle ports and idle adjustment screw ports. Turning the idle adjustment screws toward their seats reduces the quantity of fuel mixture supplied by the idle circuit.

The idle ports are slot shaped. As the throttle valves are opened, more of the idle ports are uncovered allowing a greater quantity of the gasoline and air mixture to enter the carburetor bores. The secondary throttle valves remain seated at idle.

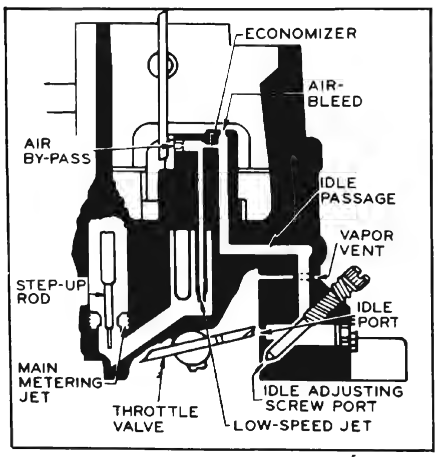


Figure 3-73—Low Speed Circuit

The low speed jets, air bleed, economizer and by-pass bushings are pressed in place in the venturi assemblies. Do not remove in servicing. If replacement is necessary, use a new venturi assembly. To insure proper alignment of the low speed mixture passage, each primary venturi assembly is designed so it can be installed on one side only.

To assist in quick hot engine starting, fuel vapor accumulated in the primary and secondary bores is vented to atmosphere through vent passages above throttle valves.

To combat engine stalling during warm-up on cool humid days, caused by "carburetor icing", exhaust gases are directed against a steel baffle plate that contacts the carburetor mounting flange. The heat transferred helps eliminate ice formation at the throttle valve edges and idle ports.

To compensate for loss of engine RPM while idling under very hot operating conditions, a thermostatic valve assembly is installed in the web between the right and left secondary venturi. When the temperature rises beyond a certain point, the calibrated thermostatic spring opens the valve. This allows additional air to flow through a special passage to an outlet below the secondary throttle valves. At normal operating temperatures, the valve should be closed. The thermostatic valve cannot be adjusted or repaired; therefore, a faulty valve must be replaced. See Figure 3-74.

d. Operation of High Speed Systems

Fuel for all except early part throttle and for all full throttle operation is supplied through the high speed system. See Figure 3-75.

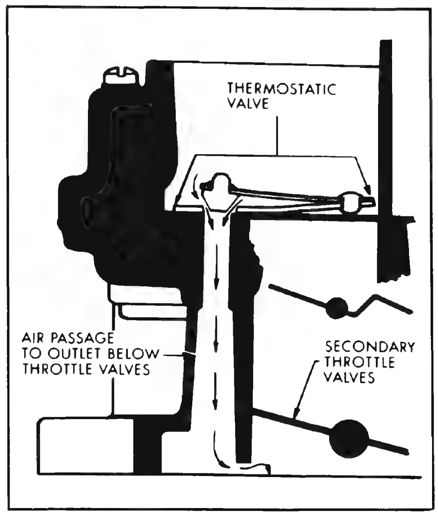


Figure 3-74—Thermostatic Valve Assembly

The position of the step-up rod in the primary main metering jet controls the amount of fuel admitted to the nozzles. The position of the step-up rod is controlled by a manifold vacuum piston.

During normal part throttle operation, manifold vacuum pulls the step-up piston and rod assembly down, holding the larger diameter of the step-up rod in the primary main metering jet. This is true when the vacuum

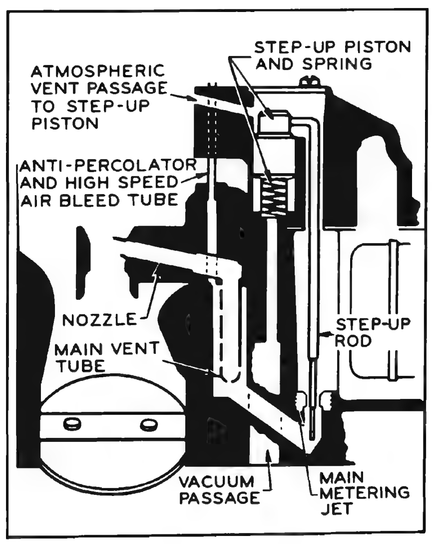


Figure 3-75—Primary High Speed Circuit

under the piston is strong enough to overcome the tension of the step-up piston spring. Fuel is then metered around the larger diameter of the step-up rod in the jet.

Under any operating condition, when the tension of the spring overcomes the pull of vacuum under the piston, the step-up rod will move up so its smaller diameter or power step is in the jet. This allows additional fuel to be metered through the jet. The step-up rod does not require adjustment.

Fuel for the high-speed circuit of the secondary is metered at the main metering jets (no step-up rods used). See Figure 3-76.

Initial discharge ports are incorporated to supplement starting of the fuel flow in the secondary high-speed circuit. These ports are located next to the venturi struts. When the auxiliary valves start to open, the vacuum on the initial discharge ports pulls fuel from the main vent tube well through passages that rise above the fuel level in the bowl. Air bleeds serve to break-up the liquid fuel and mix it with air as it moves through the passages to the initial discharge ports where it is discharged into the air stream. As the auxiliary valves continue to open, and the secondary nozzles start delivering fuel, less

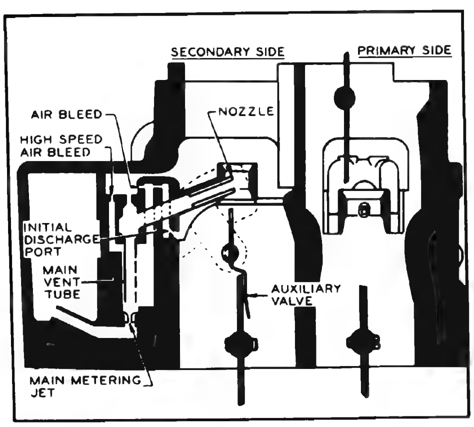


Figure 3-76—Secondary High Speed Circuit

fuel flows from the initial discharge ports.

The main vent tubes on primary and secondary sides mix air drawn through the high speed air bleed with the fuel before it passes out of the nozzles.

Air bleeds in the primary nozzle passage plugs cause the air fuel mixture to closely follow the requirements of the engine. Also, their position at the junction of the nozzle passage and the main vent tube serves to break the flow of fuel from the high speed circuit quickly as the throttle is closed upon deceleration.

A clogged air bleed or main vent tube may cause excessively rich mixtures. The high speed bleed and main vent tubes are permanently installed. If replacement is necessary, use a new venturi assembly.

The high speed bleeds also act as anti-percolator vents when a hot engine is stopped or at idling speed. This will help vent fuel vapor pressure in the high speed and idle well before it is sufficient to push fuel out of the nozzles and into the intake manifold.

Engines operated at part throttle on level road use a mixture of maximum leanness. The mixture for greatest power and acceleration is somewhat richer, and is furnished by the power and accelerating systems described later.

The high speed systems in the primary section control the flow of fuel during the intermediate or part throttle range of operation and up to approximately 85 MPH. The secondary throttle valves remain closed until the primary valves have opened approximately 50-55 degrees, after which they are opened proportionately so that all valves reach the wide open position at the same time. While the secondary valves are closed, the auxiliary valves located above them are held closed by the weights on the auxiliary valve shaft lever (Figure 3-76); therefore there is not sufficient air flow through the barrels to operate the high speed systems in the secondary section.

When the secondary throttle valves are open and the engine speed is at least 1400-1600 RPM, the resulting air flow through the secondary barrels starts to open the auxiliary valves because their supporting shaft is located off-center in the barrels. When the auxiliary valves are open the high speed systems in the secondary section also supply fuel to the engine.

e. Operation of the Power System

For maximum power or high speed operation above approximately 85 MPH, a richer mixture is required than that necessary for normal throttle opening. The richer mixture is supplied through the high speed systems in the primary section through vacuum control of the step-up rods.

Each power circuit consists of a vacuum piston located in a cylinder connected to manifold vacuum and a spring which tends to push the piston upward against manifold vacuum. See Figure 3-77.

Under part throttle operation, manifold vacuum is sufficient to hold the piston and rod down against the tension of the spring, so that the large diameter of the rod is in the metering jet for economy. When the throttle valve is opened to a point where additional fuel is required for satisfactory operation, manifold vacuum decreases sufficiently so that the piston spring moves the piston and rod upward to the small rod diameter to give the required richer mixture for power. As soon as the demand is passed

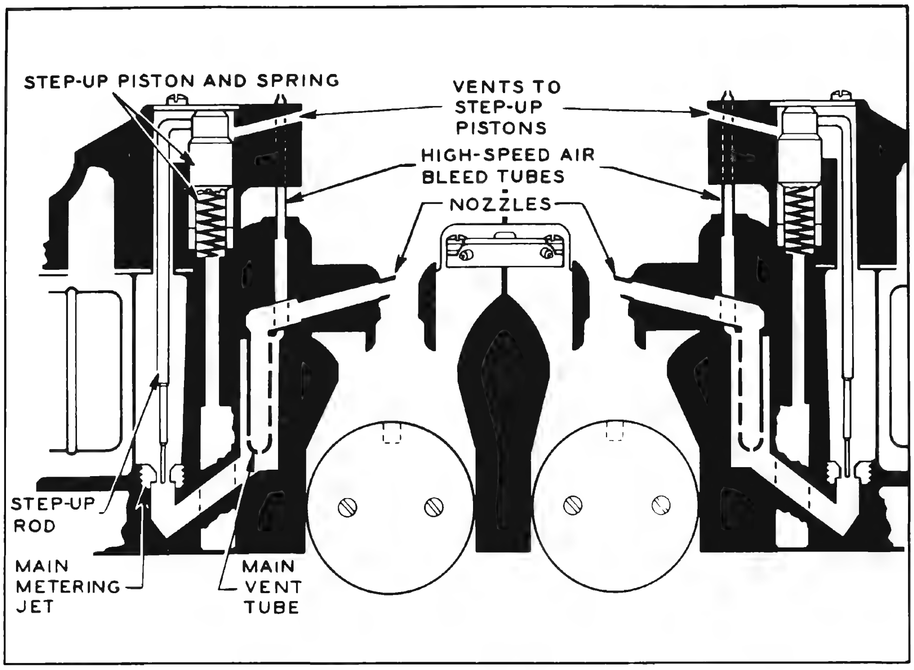


Figure 3-77—Power Circuit

manifold vacuum again moves the piston and rod down.

f. Operation of Accelerating System

The accelerating pump circuit, located in the primary side, provides a measured amount of fuel necessary to insure smooth engine operation on acceleration at lower car speeds.

When the throttle is closed, the pump plunger moves upward in its cylinder and fuel is drawn into the pump cylinder through the intake check. The discharge check is seated at this time to prevent air from being drawn into the cylinder. When the throttle is opened, the pump plunger moves downward forcing fuel out through the discharge passage, past the discharge check, and out of the pump jets. When the plunger moves downward, the intake check is closed, preventing fuel from being forced back into the bowl. See Figure 3-78.

At higher car speeds, pump discharge is no longer necessary to insure smooth acceleration. When the throttle valves are opened a predetermined amount, the pump plunger bottoms in the cylinder eliminating further pump discharge.

Be sure the pump plunger cup is in good condition and the intake and discharge checks and pump jet are free of lint, gum or other foreign matter. The pump intake check is a one piece assembly located in an angular passage at the base of the pump assembly. The intake check is serviced only as a complete assembly.

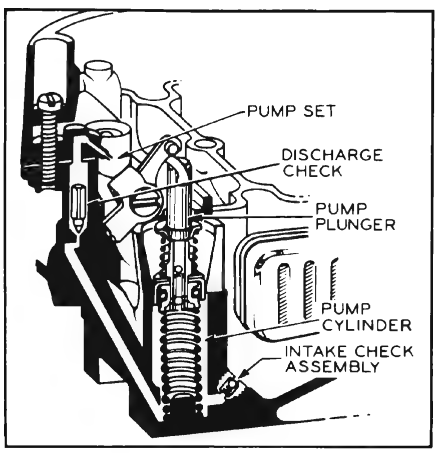


Figure 3-78—Pump Circuit

g. Operation of Choke System

The choke circuit, located in the primary side, provides the correct mixture necessary for quick cold engine starting and during engine warm-up.

When the engine is cold, tension of the thermostatic coil holds the choke valve closed. When the engine is started, air velocity against the offset choke valve causes the valve to open slightly against the thermostatic coil tension. Intake manifold vacuum applied to the choke piston also tends to pull the choke valve open. The choke valve assumes a position, where tension of the thermostatic coil is balanced, by the pull of vacuum on the piston, and force of air velocity on the offset valve.

When the engine starts, slots located in the sides of the choke piston cylinder are uncovered, allowing intake manifold vacuum to draw warm air through the climatic control housing. This air is heated in a tube running through the exhaust manifold. Clean, filtered air is used to operate the choke thermostatic coil. Air is taken from the air horn of the carburetor, down a pipe to the right exhaust manifold. The flow of warm air heats the thermostatic coil and causes it to lose some of its tension. The thermostatic coil loses its tension gradually, until the choke valve reaches the full-open position.

If the engine is accelerated during the warm-up period, the corresponding drop in manifold vacuum allows the thermostatic coil to momentarily partially close the choke, providing a richer mixture.

During the warm-up period, it is necessary to provide a fast idle speed to prevent engine stalling. This is accomplished by a fast idle cam connected to the choke linkage. The fast idle adjusting screw on the throttle lever contacts the fast idle cam and prevents the throttle valves from returning to a normal warm engine idle position, while the choke is in operation. See Figure 3-79.

If during the starting period the engine becomes flooded, the choke valve may be opened manually to clean out excessive fuel in the intake manifold. This is accomplished by depressing the accelerator pedal to the floor mat. The unloader projection on the throttle lever contacts the fast idle cam which rotates and partially opens the choke valve.

The secondary section does not have a choke valve. In order to prevent air entering the carburetor through the secondary side during the engine warm-up period, it is necessary to lock the secondary throttle valves in the closed position. This is accomplished by engagement of a lock-out arm with a locking tang on the secondary valve shaft lever. See Figure 3-79.

With the choke valve in wide open position the lock-out arm rests in a lowered position, clear of the secondary valve shaft lever. As the choke valve closes it rotates the fast idle cam trip lever, allowing the lock-out arm to rise. As soon as the choke valve is closed a few degrees from wide open position, the notch in the lock-out arm lies in the line of travel of the locking tang on the secondary valve shaft lever, thereby preventing the shaft and valves from turning.

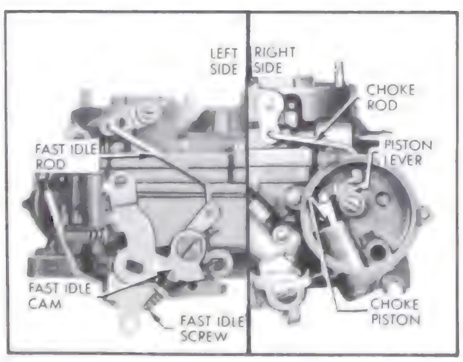


Figure 3-79—Choke Linkage

The choke fast idle linkage permits the choke valve to float in that it can close a few degrees, if necessary, should the engine falter while running on fast idle during the warm-up period. When the engine starts, manifold vacuum applied to the choke piston pulls the choke valve partially open. Should the engine falter, the choke piston will sense the condition because of the reduction in vacuum and allow the tension of the thermostatic coil to partially close the choke, providing a slightly richer mixture to smooth out the engine's performance. This feature of allowing the choke valve to close partially while the fast idle screw is in contact with the cam helps prevent stalling during the warm-up period. The choke valve is allowed to come open during the warm-up period if the car is left running on fast idle while warming up.

3-23 DISASSEMBLY, CLEANING, INSPECTION OF CARTER 4-BARREL CARBURETOR

1. Remove pin spring from upper end of choke rod and disconnect rod from choke shaft lever. Reinstall pin spring on choke rod for safe keeping.

2. Remove retainer and spring from upper end of pump rod and disconnect rod from pump arm. Reinstall spring and retainer on pump rod.

3. Remove screws holding two step-up piston cover plates to air horn. Remove cover plates and remove each step-up piston, rod, and rod retainer spring as an assembly. Then remove two step-up piston springs. See Figure 3-80.

4. Remove screw from end of choke shaft and remove outer lever and washer. Then remove inner lever and fast idle rod from carburetor as an assembly. Remove choke valve attaching screws. Remove choke valve and shaft.

5. Remove fuel inlet fitting and gasket. Remove all air horn screws and lock washers, noting location of attached cable clip. Remove air horn and gasket from main body, lifting straight up to avoid damaging floats or pump plunger.

6. Remove float lever pins and floats. Remove float needles, needle seats, and gaskets. Keep float system parts separated so that they may be reinstalled in original location with a minimum amount of adjusting.

7. Remove pin spring from pump link. Remove link and reinstall pin spring. Remove pump plunger assembly from air horn. Remove air horn gasket.

8. Remove lower pump spring from main body. Remove thermostatic coil and housing assembly, gasket, and baffle plate from

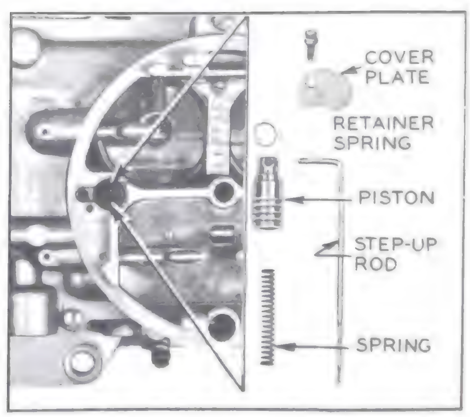


Figure 3-80—Step-Up Rod and Related Parts

choke piston housing. Remove screw from end of choke piston housing shaft and remove washer. Then remove choke piston, lever, link and pin assembly.

9. Remove piston housing from main body. Remove small round gasket from piston housing. Remove choke shaft, lever, and rod assembly from piston housing.

10. Remove idle mixture adjustment screws and springs.

11. Remove thermostatic valve and gasket. See Figure 3-74.

12. Remove both secondary venturi assemblies and gaskets. Remove auxiliary valve assembly. Remove both primary venturi assemblies and gaskets. Notice that each venturi assembly is different and can be assembled in only one location. Notice also that primary venturi assembly gaskets are different from secondary gaskets.

13. Remove pump jet housing and gasket. Remove pump discharge check needle.

14. Remove all four metering jets. Notice that the primary jets have larger orifices than the secondary jets. This is because step-up rods are used only in the primary jets.

15. Remove pump intake ball check assembly.

Unless passages in main body appear to be clogged with carbon or gum to such an extent that penetration of cleaning solution is doubtful, it is seldom necessary to remove passage plugs.

For normal cleaning and inspection, it is not necessary to remove primary or secondary throttle valves and their connecting linkage. However, if throttle linkage is worn or damaged, service replacement parts are available.

3-24 ASSEMBLY AND INTERNAL ADJUSTMENT OF CARTER 4-BARREL CARBURETOR

During assembly of carburetor use all new gaskets and any additional new parts found to be necessary during inspection. Calibrated parts must be as specified for carburetor CODE number which is stamped in edge of mounting flange at rear center.

1. Place main body in upright position on bench or mounting fixture. Install primary and secondary metering jets and tighten securely. NOTE: The primary jets are the two having the larger orifices and are installed in the holes nearest the center of the main body below step-up rod holes in air horn.

2. Install pump discharge check needle point down. Install pump jet housing and gasket. Install pump intake ball check assembly.

3. Install thermostatic valve using new gasket. See Figure 3-74.

4. Install auxiliary valve assembly with screw heads down. Then install secondary and primary venturi assemblies, using new gaskets. NOTE: If a primary venturi assembly does not fit in place flush with top of main body, it belongs on other side.

5. Install idle mixture adjustment screws. Seat lightly and back out 1-1/2 turns, which will provide an average initial adjustment.

6. Install choke piston housing shaft, lever and rod assembly in piston housing with lever and rod pointing away from heat pipe connector. Install small round rubber gasket in housing recess, then install piston housing on main body using three self tapping screws. Install choke piston, pin, link and lever assembly in piston housing. Install piston lever on flats of shaft in such a way that inner and outer levers are pointing in same general direction. Then install screw.

7. Place pump plunger assembly in position in air horn and install pump link. Install pin spring in upper end of link. Invert air horn and install new air horn gasket.

8. Install float needle seats and gaskets. Install float needles, floats, and lever pins, making sure they are installed in original locations.

9. Align Float - Sight down side of float to determine if side is parallel with outer edge of air horn. If adjustment is necessary, bend float lever by applying pressure to end of float with fingers while supporting float lever with thumb. See Figure 3-81.

Remove any excess clearance between arms of float lever and lugs on air horn by bending float lever arms. Arms should also be parallel to inner surfaces of lugs. After aligning, each float must operate freely.

10. Adjust Float Level. With air horn inverted and air horn gasket in place, check clearance between each float (at outer end) and air horn gasket using 7/32" gauge or a 7/32" drill. See Figure 3-82. To adjust, bend float lever. After

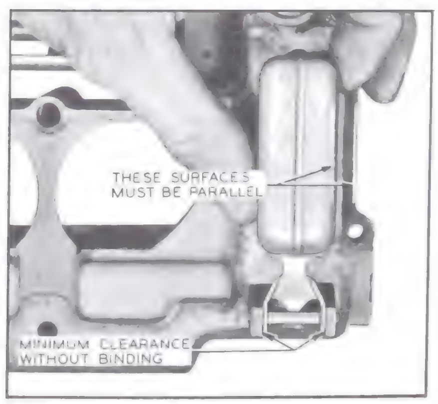


Figure 3-81—Float Alignment

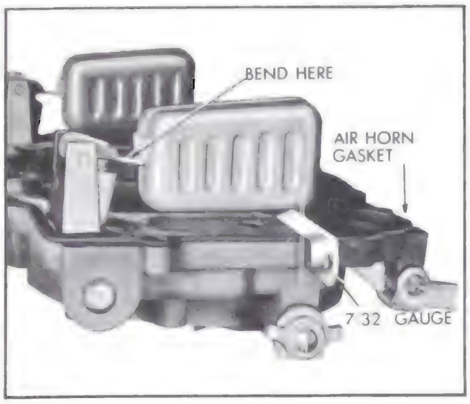


Figure 3-82—Checking Float Level

any adjustment, recheck float alignment.

11. Adjust Float Drop. With air horn held in upright position, measure vertical distance from air horn gasket to outer end of each float using a scale. Bend float arm tang as required to obtain 3/4" measurement. See Figure 3-83.

12. Place lower pump spring in pump well (opposite choke piston housing). Install air horn assembly on main body, using care to avoid distortion of floats. Install air horn screws and tighten evenly. (Two longer screws go in middle holes.) Check auxiliary valve assembly by opening from above. Auxiliary valves must be perfectly free in any position.

13. Install choke shaft in air horn with attached lever toward choke piston housing. Install choke valve with markings up and install screws loosely. Align choke valve by working choke shaft endwise while maintaining an upward pressure on choke shaft lever. Tigten and stake choke valve screws. Check for uniform clearance and freedome from sticking, as improper fit or binding may cause hard starting. Mechanism is free if choke valve will fall open from its own weight.

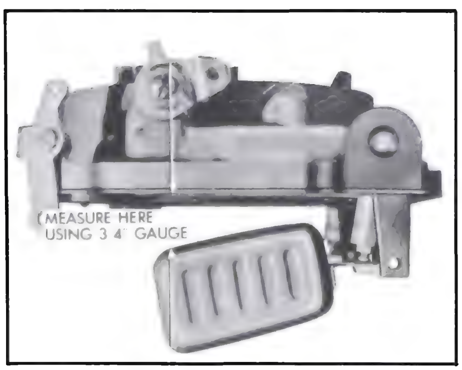


Figure 3-83—Checking Float Drop

14. Install assembled fast idle rod and choke lever by first engaging fast idle rod in fast idle cam. Then place lever over end of choke shaft so that it points toward accelerator pump with choke closed.

15. Install two step-up piston springs. Install each assembled retainer spring. Carefully push down on each step-up piston and rod until rod enters metering jet. Use care to avoid bending step-up rods. Then install cover plates, holding plates down while tightening screws.

16. Install upper end of pump rod in pump arm. Install spring and retainer on rod, making sure that bronze washer is on opposite side of pump arm from spring.

17. Install upper end of choke rod in choke shaft lever, using pin spring on rod.

3-25 EXTERNAL ADJUSTMENT OF CARTER 4-BARREL CARBURETOR

1. Adjust Choke Piston Position. Inside choke piston bore on left side, about 1/2 inch down, is a small slot. Insert 1/8 inch bent end of .026" wire gauge into upper end of slot; then close choke valve until piston stops against gauge. Check opening between upper edge of choke valve and inner wall of air horn using .115" Wire Gauge. See Figure 3-84. If adjustment is required, place Tool J-5197 on lower section of choke rod and bend as necessary.

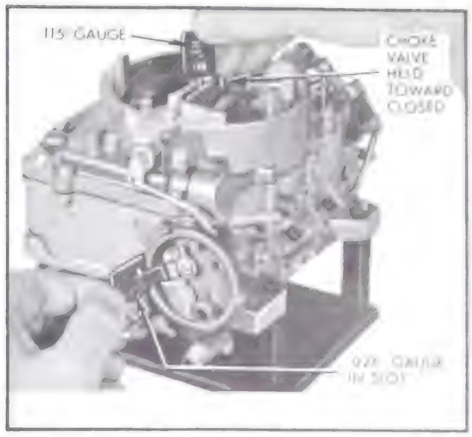


Figure 3-84—Choke Piston Adjustment

2. Install baffle plate in choke piston housing. Install thermostatic coil and housing assembly with gasket. Rotate clockwise until index marks align and choke valve is just closed, then tighten screws and retainers.

3. Adjust Pump. Push fast idle cam aside and back out throttle stop screw until throttle valves seat in throttle bores. With pump rod in center hole, measure from air horn to top of plunger shaft with scale. Bend pump rod at lower angle as required to obtain 7/16" measurement using Tool J-4552. See Figure 3-85. Turn throttle stop screw in (from fully closed throttle position) 3/4 turn which should provide an initial idle adjustment.

4. Adjust Fast Idle Cam Position. With choke valve held fully closed, open throttle slightly to allow fast idle cam to spring to

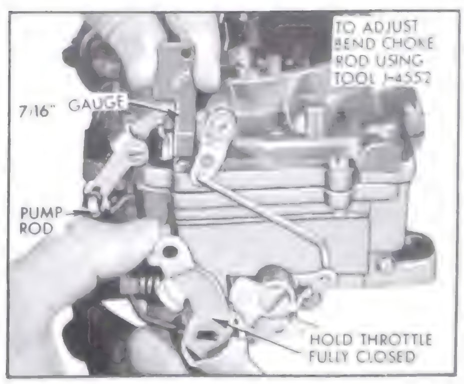


Figure 3-85—Pump Adjustment

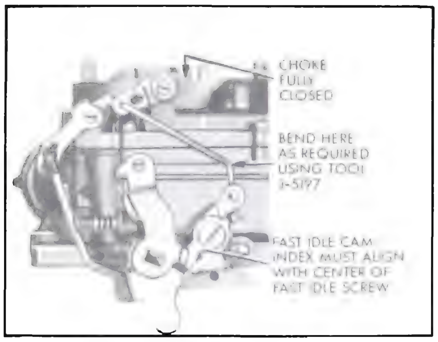


Figure 3-86—Fast Idle Cam Adjustment

a neutral position. Now index mark on fast idle cam must align with center of fast idle screw. If mark does not align, bend fast idle rod using Tool J-5197 as required to make mark align. See Figure 3-86.

NOTE: <u>With choke fully closed and index mark aligned, lug on fast idle cam must clear stop on throttle body.</u>

5. <u>Adjust Unloader.</u> Hold throttle wide open and check clearance between upper edge of choke valve and inner wall of air horn using the 7/32" gauge or a 7/32" drill. Bend unloader tang on throttle shaft lever as required to obtain this clearance using pliers. See Figure 3-87.

6. <u>Adjust Closing Shoe.</u> Hold choke open and rotate primary throttle lever through full range. Check clearance between positive closing shoes on primary and

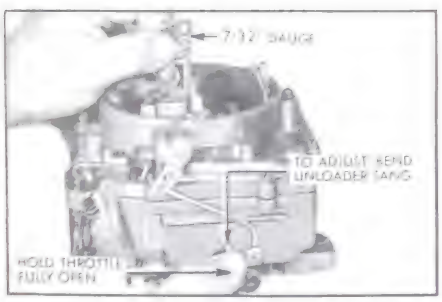


Figure 3-87—Unloader Adjustment

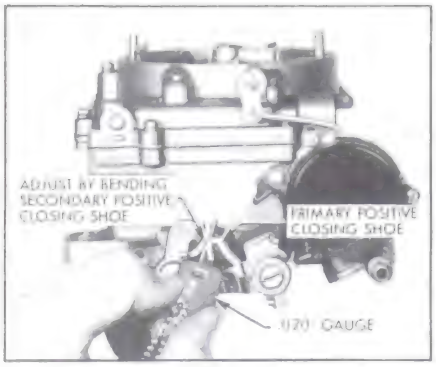


Figure 3-88—Closing Shoe Adjustment

secondary throttle levers at closest position using .020" gauge. Bend secondary closing shoe as required to obtain this clearance using pliers. See Figure 3-88.

7. <u>Adjust Throttle Opening.</u> At wide open throttle, primary throttle valves should be vertical. Secondary throttle valves should be a few degrees from vertical. Upper edge of secondary valves should just contact auxiliary valves when both are wide open. If necessary, bend wide open stop lug.

Primary and secondary throttle valves should reach wide open throttle at the same time. To synchronize, bend secondary operating rod. See Figure 3-89.

The pick-up lever located on the primary throttle shaft has two points of contact with the loose lever on the primary shaft. Caution should be taken that the pick-up lever contacts the loose lever

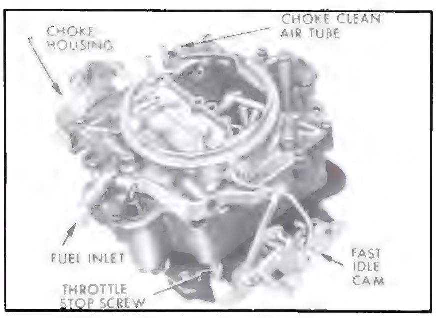


Figure 3-89—Secondary Throttle Opening Adjustment

at both points at the same time. See Figure 3-89. If they do not make this contact, bend pick-up lever to obtain proper engagement.

8. <u>Adjust Secondary Throttle Lock-Out.</u> Open primary throttle valves slightly to clear fast idle cam and manually open and close choke valve. Lock-out tang on secondary throttle should freely engage in notch of lock-out dog while barely missing edge of notch. If necessary to adjust, bend tang on secondary throttle lever using Tool J-6058-A. See Figure 3-90.

Install carburetor on car. Make final idle speed and mixture adjustments on car in normal manner. See Paragraph 3-8.

9. <u>Adjust Fast Idle.</u> Make adjustment on car with engine operating at normal temperature and transmission in drive as follows:

(a) Position fast idle cam so that fast idle screw is resting on low step of fast idle cam with edge of screw aligned with starting edge of cam.

(b) Adjust fast idle screw so that engine runs 600 RPM.

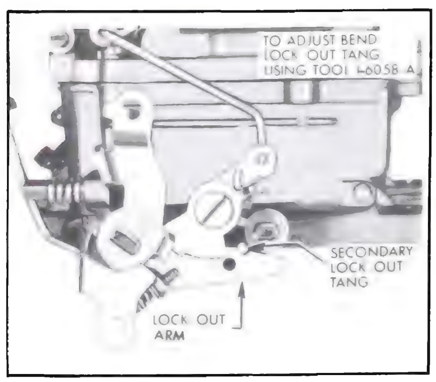


Figure 3-90—Secondary Throttle Lock-Out Adjustment

SECTION 3-H

CARTER DUAL 4-BARREL CARBURETORS

CONTENTS OF SECTION 3-H

3-26 DESCRIPTION AND OPERATION OF CARTER DUAL 4-BARREL CARBURETORS

The Carter Model AFB 4-barrel carburetors used in the 425 cubic inch engine dual 4-barrel option are very similar to single 4-barrel Carter carburetors. To aid in description, the carburetors will be referred to as front and rear carburetors. Each carburetor, of course, has a primary section (consisting of the 2-barrelled forward half) and a secondary section (consisting of the 2-barrelled rearward half). Although fuel for idling is supplied by the primary section of both carburetors, fuel for all other operation except for hard acceleration or extreme high speeds is provided by the primary section of the rear carburetor only. Only the rear carburetor is equipped with an automatic choke and a clean air system for the choke. The rear carburetor also provides connections for the positive crankcase ventilator and the distributor vacuum advance unit.

The front carburetor (primary section) has fixed idle orifices. Only the rear carburetor (primary section) has idle mixture adjusting needles and an idle speed adjustment. This speed adjustment is of the idle by-pass type; all throttle valves are closed tight, so all air flow at idle is metered by a single brass air adjustment screw in a by-pass channel.

Operation of the dual carburetor system from idle to wide open is as follows: As the accelerator pedal is gradually depressed, the primary of the rear carburetor starts to open. When it is approximately half open, the primary of the front carburetor starts to open. Next the secondary of the rear carburetor starts to open, and last, the secondary of the front carburetor starts to open. Each of the four sections opens at such a rate that all throttle valves reach the wide open position at the same time.

3-27 SERVICING CARTER DUAL 4-BARREL CARBURETORS

The disassembly, cleaning, inspection and assembly procedures are the same as in Section 3-G. The internal and external carburetor adjustments are also made in a similar manner, but some of the dimensions differ from those for the single 4-barrel Carter. For dual 4-barrel specifications, see page 3-2.

3-28 THROTTLE LINKAGE ADJUSTMENTS—DUAL 4-BARREL CARBURETORS

a. Throttle Linkage Adjustments

1. Move rear carburetor throttle lever to wide open position, making sure that nothing prevents lever from actually contacting carburetor casting.

2. Unsnap front end of rear throttle rod assembly from throttle lever. While another man presses accelerator pedal firmly against floor mat, hold rear throttle in wide open position and adjust rear throttle rod length so that its socket aligns with the ball on the throttle lever. Then shorten rear throttle rod two turns and snap socket on throttle lever ball.

3. With both carburetors held at closed throttle, adjust turnbuckle until it just contacts trunnion of front carburetor, then back-off turnbuckle one turn and tighten lock nut. See Figure 3-91.

4. With both carburetors held at wide open throttle, adjust bolt until it just contacts trunnion of front carburetor. (Bolt is self-locking.)

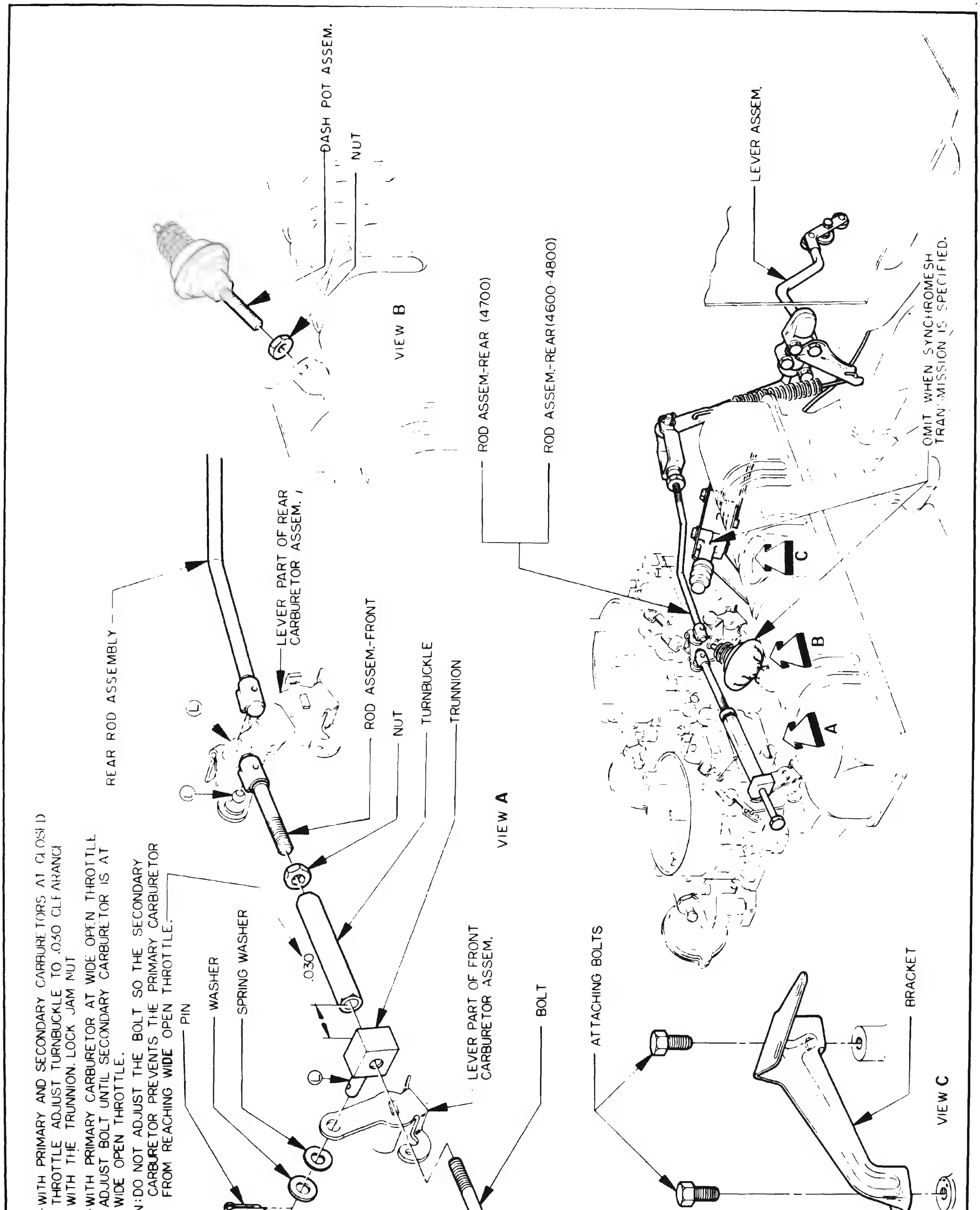


Figure 3-91—Throttle Control Information-Dual 4-Barrel

b. Transmission Detent Switch Adjustment (Automatic Transmission Cars)

With rear carburetor held at wide open throttle, adjust detent (down-shift) switch plunger so that it is approximately .050" inch from bottom.

c. Dash Pot Adjustment (Automatic Transmission Cars)

1. Loosen dash pot lock nut.

2. While holding rear carburetor fully closed, rotate dash pot until plunger just touches throttle lever. Make a reference mark on dash pot, then rotate it 5 turns toward throttle lever (depressing plunger).

3. Retighten lock nut.

3-29 IDLE SPEED AND MIXTURE ADJUSTMENTS—DUAL 4-BARREL CARBURETORS

The positive crankcase ventilator valve should be checked as described in paragraph 3-7 before making idle adjustments, as this valve noticeably affects the air-fuel ratio at idle. Adjust idle speed and mixture as follows:

1. Remove air cleaner. Connect a tachometer from distributor terminal of coil to ground.

2. Start engine and run it at fast idle until upper radiator tank is hot and choke valve is wide open.

3. On automatic transmission cars, place a block in front of a front wheel and apply parking brake firmly, then shift transmission into drive.

4. Make sure that all throttle valves close fully, then set idle speed at 500 RPM by turning brass air adjustment screw in rear carburetor.

5. Turn idle mixture needles alternately to obtain highest tachometer reading.

6. Each time an improved mixture setting increases the idle speed, the air adjustment screw must be turned inward to decrease the idle speed to 500 RPM. Since this is strictly an air adjustment, this throws-off the idle mixture. For this reason, always adjust idle mixture needles last.

7. Press a finger on the brass valve of each idle compensator to see if idle speed drops because compensator was open. If speed drops, readjust idle, making sure compensator remains closed.

GROUP 4

CLUTCH, S-M TRANSMISSIONS

SECTIONS IN GROUP 4

SECTION 4-A

4400 CLUTCH

CONTENTS OF SECTION 4-A

4-1 CLUTCH SPECIFICATIONS

a. Tightening Specifications

Part	Location	Thread Size	Torque Ft.-Lbs.
Bolt	Clutch Cover to Flywheel	3/8-16 x 1	30-40
Stud	Clutch Release Fork Ball	3/16-16	35-45
Bolt	Transmission to Flywheel	1/2-13 x 1 1/2	45-60
Bolt	Flywheel Housing to Cylinder Block	3/8-16 x 1 1/4	30-40

b. Clutch Specifications

Type	Single Plate Dry Disc
Pedal Pressure	28 - 30 lbs.
Pedal Lash	3/4" to 1"
Driven Plate Diameter	10 13/32"
Driven Plate Facings	Woven Asbestos
Number of Facings	2
Facing Attachment	Riveted
Facing Area (Sq. in.)	106.81
Vibration Damping	6 Springs

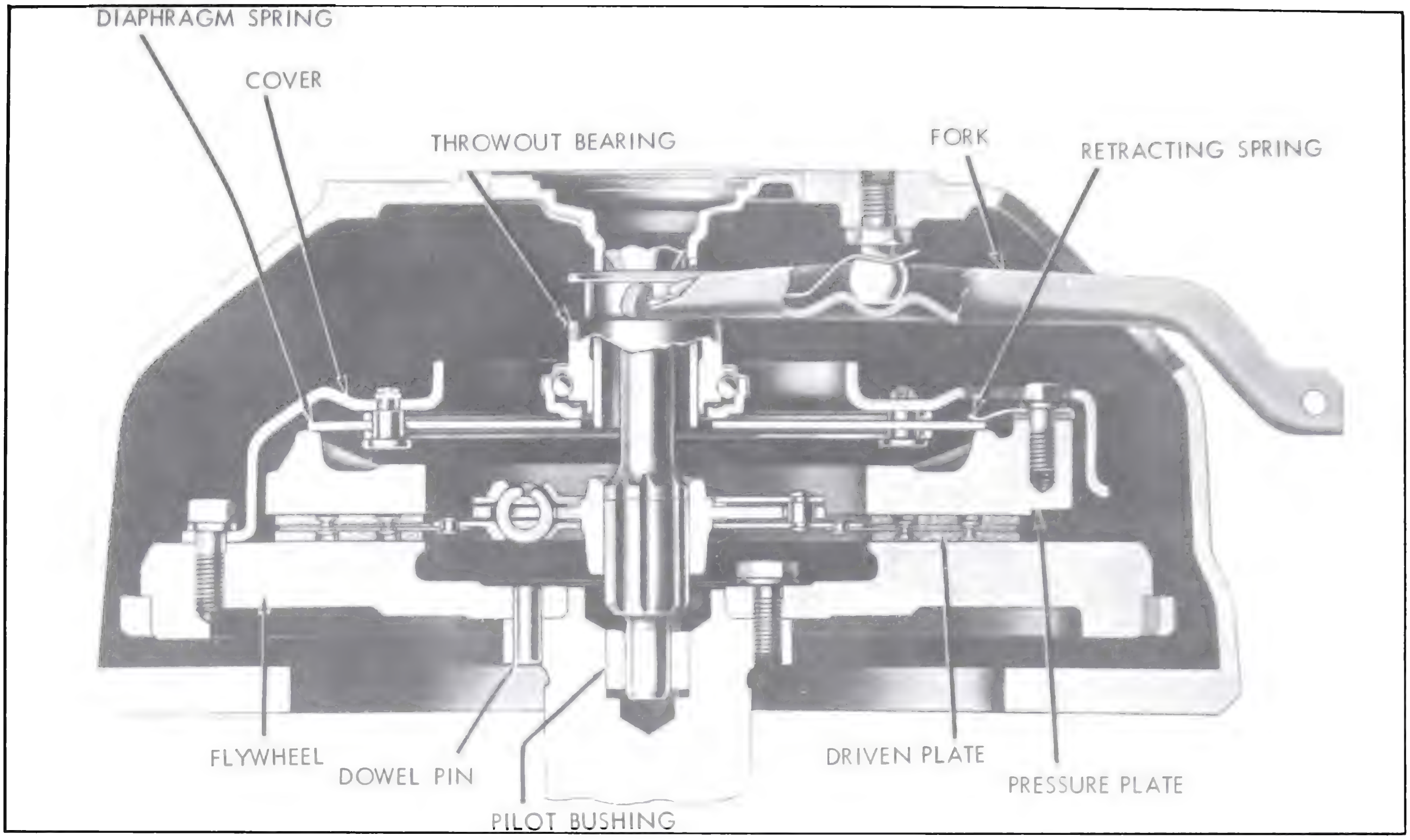


Figure 4-1—Standard Clutch

4-2 CLUTCH DESCRIPTION

All 4400 synchromesh cars are equipped with a single plate dry disc clutch, using a diaphragm spring assembly. See Figure 4-1.

a. Release

Depressing the clutch pedal causes movement of the clutch fork in the direction shown in Figure 4-2. Actual operation of the linkage in this operation is explained in paragraph C below. The clutch fork, pivoting on a ball stud, acts upon the throw out bearing. The bearing in turn, forces the tangs of the diaphragm spring in the direction shown in Figure 4-2. The diaphragm spring, being retained in the clutch cover by 9 rivets and 2 wire rings, is mounted in such a way that the spring can pivot or dish on these rings, again reversing the direction of force. This force is applied directly to the 3 retracting springs which, in turn, pull the pressure plate rearward and out of contact with the driven plate.

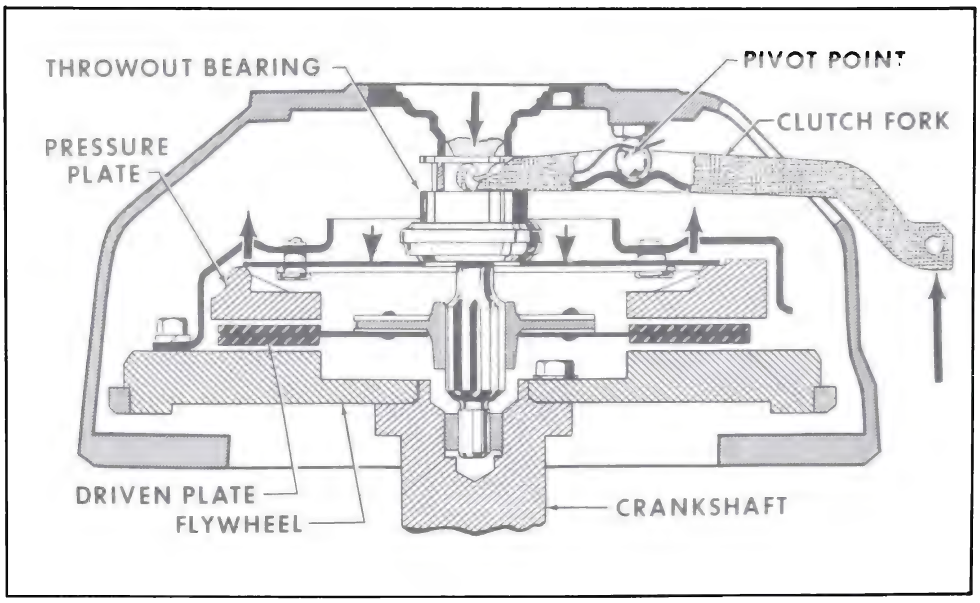


Figure 4-2—Clutch Releasing Action

b. Clutch Driven Plate

The clutch driven plate assembly is mounted with a free sliding fit on the transmission main drive

gear and is keyed to the gear by ten splines. The front end of the main drive gear is piloted by a bushing pressed into a recess in the rear end of the engine crankshaft. See Figure 4-1.

The outer area of the driven plate is divided into segments which are formed in low waves to provide springs between the plate facings and thereby cushion engagement of the clutch. A molded facing, grooved to give release, is riveted to each side of every segment of the plate. When the clutch is fully released, the waved segments cause the facings to spread approximately .055" and the movement of pressure plate provides an additional clearance of approximately .030" to assure full release of driven plate. See Figure 4-2.

The driven plate assembly is designed to prevent torsional periods of the engine from being transmitted to the transmission gears and causing rattle. This is accomplished by driving the plate hub through torsional coil springs and providing frictional dampening by means of friction between disc and the nuts.

c. Clutch Linkage

The clutch pedal is the suspended type and pivots on a shaft which extends thru a bracket bolted to the cowl. The pedal arm returns against a rubber bumper. See Figure 4-3.

The clutch operating rod extends from the clutch pedal thru the cowl, where it is retained to the equalizer operating rod by a washer and clip. The clutch equalizer operating rod is joined with the operating lever by the equalizer shaft. Projections extending from the spherical ends of the equalizer shaft interlock with the equalizer rod at one end, and the equalizer lever at the other. The entire equalizer unit is supported by a pivot stud attached to the crankcase, and a bracket attached to the frame. See Figure 4-3.

A rod, threaded at one end, is attached to the equalizer lever and is provided with a locking nut for adjustment purposes. The other end is spherical and pivots in an indentation in the clutch fork. Movement of the equalizer assembly is thus transmitted to the clutch fork. Pedal return is provided by a spring between the clutch fork and the frame.

4-3 CLUTCH TROUBLE DIAGNOSIS

a. Excessive Pedal Pressure

The normal pressure required to depress the clutch pedal varies between 28 and 33 lbs. Minimum pedal pressure is required when the car is new. It is a normal condition for the pedal pressure to increase as mileage increases. If excessive pressure is encountered (over 40 lbs.), it is logical to suspect a worn driven plate. However, linkage bind due to misadjustment or lack of lubrication can also increase pedal pressure.

b. Noise

Squeaking and grinding noises during clutch pedal operation are usually caused by heavy friction in the release linkage or internal parts of clutch assembly. Before condemning the throw-out bearing, thoroughly lubricate equalizer and, if necessary, lubricate internal working parts of clutch as described in paragraph 4-5.

c. Clutch Grab or Chatter

A very slight amount of oil on driven plate facings will cause clutch grab and chatter. A new driven plate must be installed if original plate facings contain oil since removal of oil from facings is not practical.

When oil is found on facings, examine pilot bushing, transmission drainback, rear engine bearing, and oil leaks which might drain back into clutch housing between upper and lower flywheel housings.

d. Clutch Drag or Failure to Release

To test for clutch drag or failure to release depress clutch pedal to toeboard and put into low gear. Hold pedal depressed and shift transmission to neutral, wait about 15 seconds with pedal depressed and again shift into low gear. If clutch is not releasing completely a gear clash will occur.

If test shows that clutch is not releasing properly, check clutch pedal lash (par. 4-4) and check release linkage for lost motion. Correct as necessary and again test for clutch drag.

If clutch drag cannot be corrected in release linkage, remove clutch and check height of release levers. Check driven plate for oil soaked or cracked facings, also for run-out and free movement on main drive gear (par. 4-6).

e. Clutch Slipping

First make certain that clutch pedal is adjusted for specified lash (3/4" to 1") and that pedal is not binding. One type of clutch slippage is sometimes wrongly diagnosed as due to a weak clutch spring. This slippage occurs during gear shifting, and full engagement of the clutch is not obtainable until the engine speed is reduced. After full engagement is obtained, no further slippage occurs during acceleration or

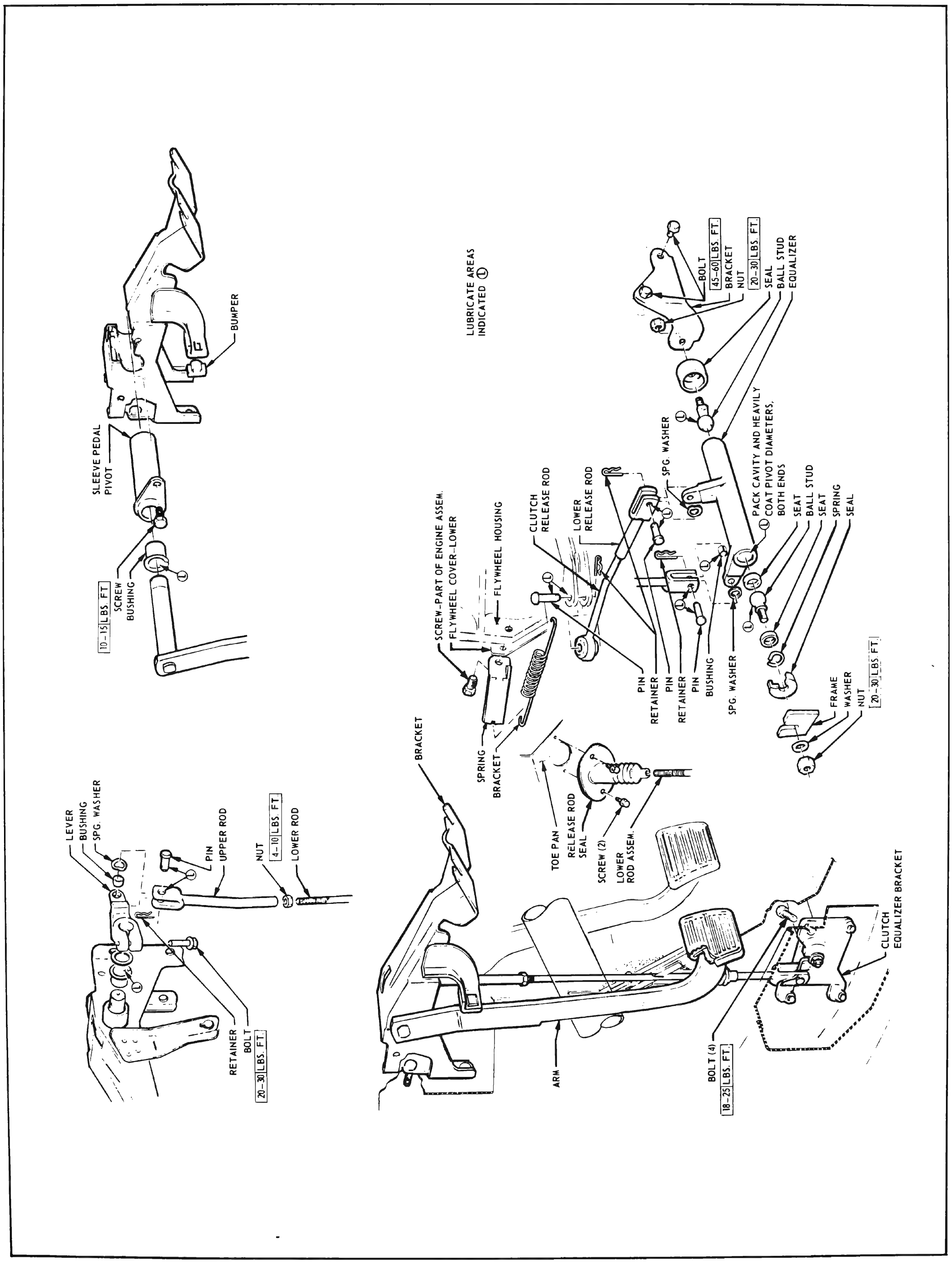


Figure 4-3—Clutch Linkage

under full load. This condition is usually due to the clutch driven plate hub sticking on the splines of the transmission main drive gear. Correction can be made by removing the clutch and thoroughly cleaning splines of driven plate and clutch gear then applying a light coating of Lubriplate.

4-4 CLUTCH ADJUSTMENT

Pedal lash (free pedal) must be adjusted occasionally to compensate for normal wear of clutch facings. As the driven plate wears thinner, pedal lash decreases.

It is very important to maintain pedal lash at all times. Insufficient pedal lash will cause the throw-out bearing to ride against the diaphragm spring tangs constantly, resulting in abnormal wear of these parts. It may also cause clutch slippage and abnormal wear of the driven plate, flywheel, and pressure plate if pressure on the spring tangs is enough to prevent positive engagement of the clutch.

Check pedal lash (free pedal) by pushing on the pedal pad with the hand. Pedal lash should be 3/4" to 1" measured at the pedal pad. (See Figure 4-3).

Adjust pedal lash as follows:

1. Check pedal at full release position, making sure it contacts rubber stop.

2. Adjust clutch release rod to give zero lash at pedal.

3. Back off release rod 3 full turns.

4. Check pedal lash. If not between 3/4" and 1", adjust release rod further.

5. When lash is at desired dimension, tighten locknut. Torque to 5-15 ft. lbs.

4-5 REMOVAL, LUBRICATION AND INSTALLATION OF CLUTCH

a. Removal from Vehicle

1. Remove transmission as outlined in Section 4-C.

2. Remove clutch throw-out bearing from the fork.

3. Remove clutch fork tension spring from fork. Disconnect clutch fork push rod.

4. Disconnect clutch fork from ball stud by forcing it toward the center of the vehicle.

5. Mark clutch cover and flywheel with a center punch so that cover can be reinstalled in the same position on flywheel in order to preserve engine balance.

6. Loosen the clutch attaching bolts one turn at a time until diaphragm spring is released.

7. Support pressure plate and cover assembly while removing last bolts, then remove pressure plate, then the driven plate.

8. Remove three drive-strap to pressure plate bolts and retracting springs and remove pressure plate from clutch cover.

NOTE: When disassembling, note position of grooves on edge of pressure plate and cover. These marks must be aligned in assembly to maintain balance.

9. The clutch diaphragm spring and two pivot rings are riveted to the clutch cover. Spring, rings and cover should be inspected for excessive wear or damage and if there is a defect, it is necessary to replace the complete cover assembly.

b. Lubrication of Clutch

Lubrication of the clutch release equalizer is required when the clutch is overhauled; if lubrication becomes necessary between overhauls to eliminate squeaks or excessive pedal pressure, the clutch must be removed from the car.

1. Very sparingly apply wheel bearing lubricant in pilot bushing in crankshaft. If too much lubricant is used, it will run-out on face of flywheel when hot and ruin the driven plate facings. Make sure that surface of flywheel is clean and dry.

2. Make sure that splines in driven plate hub are clean and apply a light coat of Lubriplate.

Apply a light coat of Lubriplate on transmission drive gear splines. Slide driven plate over transmission drive gear several times. Remove driven plate and wipe off all excess lubricant pushed-up by hub of plate. Driven plate facings must be kept clean and dry.

3. Fill groove in throw-out bearing with wheel bearing lubricant (See Figure 4-5). Make sure transmission front bearing retainer sleeve is clean and apply a light coat of wheel bearing lubricant. Slide throw-out bearing over transmission retainer several times. Remove throw-out bearing and wipe off all excess lubricant pushed up by hub of bearing.

4. Apply Lubriplate to ball stud in flywheel housing and to ball seat in clutch fork.

5. Check clutch pilot bearing for excessive wear or damage. If replacement is necessary, remove with J-1448. To replace bearing use J-1522 as shown in Figure 4-4.

c. Installation

1. Install the pressure plate in the cover assembly, lining up the groove on the edge of the pressure plate with the groove on the edge of the cover.

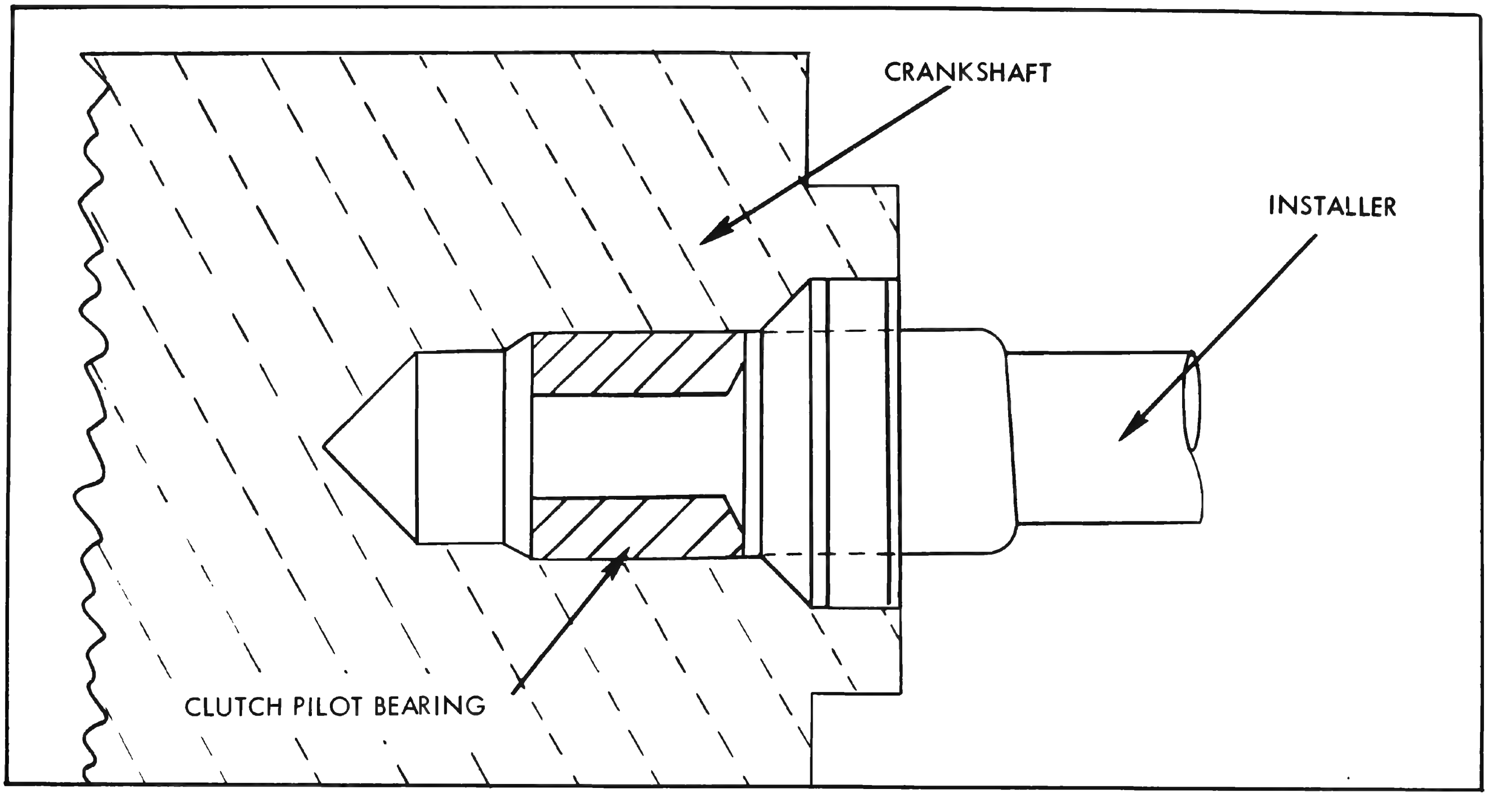


Figure 4-4—Pilot Bearing Installation

2. Install pressure plate retracting springs and drivestrap to pressure plate bolts and lock washers. Torque to 11 ft. lbs. The clutch is now ready to be installed.

3. With clutch fork in housing, but not on ball stud, install clutch disc, pressure plate and cover assembly. Support them with a spare clutch gear. Be sure to align marks on clutch cover with marks on flywheel.

4. Install bolts in every other hole in cover assembly first and pull down slowly until tight. Then install remaining 3 bolts.

5. Remove clutch gear used as a pilot.

6. Replace clutch fork on the ball stud.

7. Lubricate the recess on the inside of the throw-out bearing collar and coat the throw-out fork groove with a small amount of wheel bearing grease. See Figure 4-5. Do not use too much lubricant.

8. Install throw-out bearing to the clutch fork, and install linkage.

9. Install transmission as outlined in Section 4-3.

4-6 INSPECTION OF CLUTCH

Wash all metal parts of clutch, except release bearing and driven plate, in suitable cleaning solution to remove dirt and grease. Soaking release bearing in cleaning solution would permit solution to seep into bearing and destroy the lubricant. Soaking driven plate

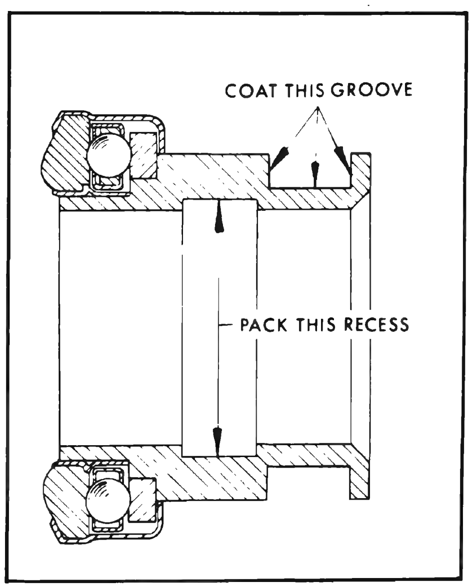


Figure 4-5—Throw-out Bearing Lubrication

in cleaning solution would damage the facings.

1. Flywheel and Pressure Plate. Examine friction surfaces of flywheel and pressure plate for scoring or roughness. Slight roughness may be smoothed with fine emery cloth, but if surface is deeply scored or grooved the part should be replaced.

2. Clutch Cover. Inspect clutch cover for cracks or distortion. Check clearance between pressure plate driving lugs and edges of slots in cover, using feeler gauges. The clearance should be .005" to .008"; excessive clearance may cause rattle when engine is intermittently accelerated with clutch disengaged.

3. Clutch Driven Plate. Inspect driven plate for condition of facings, loose rivets, broken or very loose torsional springs, and flattened cushion springs.

If facings are worn down near rivets or are oily, the plate assembly should be replaced. A very slight amount of oil on clutch facings will cause clutch grab and chatter. A large amount of oil on facings will cause slippage. Removal of oil by solvents or by buffing is not practical since oil will continue to bleed from facing material when hot.

When oil is found on driven plate facings, examine transmission drainback hole, pilot bushing, engine rear main bearing and other points of oil leakage.

Test the fit of driven plate hub on transmission main drive gear for an easy sliding fit.

4. Bearings. Inspect clutch release bearing for scoring or excessive wear on front contact face. Test for roughness of balls and races by pressing and turning front race slowly. Inspect main drive gear pilot bushing in crankshaft. If bushing is rough or worn it should be replaced.

Regardless of whether the old plate or a new one is to be installed, the plate should be checked for run-out. This check

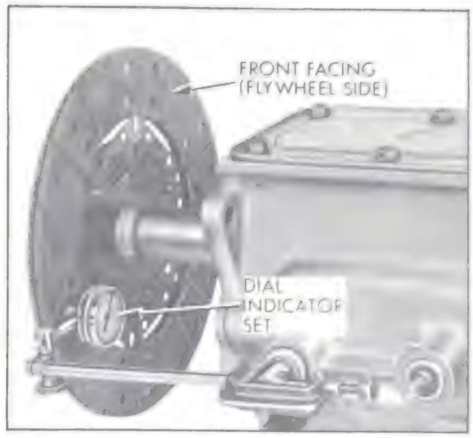


Figure 4-6—Checking Driven Plate for Run-Out

can be made by sliding the driven plate, front side first, over the transmission main drive gear until it is tight on the spline, then setting up a dial indicator to bear against the plate facing as shown in Figure 4-6. While holding firmly against front end of main drive gear to take up play in main drive gear bearing, slowly rotate driven plate and observe the amount of run-out shown by indicator. If run-out of front facing exceeds .025" the plate should not be used since it is not practical to correct excessive run-out by bending.

SECTION 4-B
4600 CLUTCH

CONTENTS OF SECTION 4-B

4-7 CLUTCH SPECIFICATIONS

a. Tightening Specifications

Part	Location	Thread Size	Torque Ft. Lbs.
Bolt	Clutch Cover to Flywheel	5/16-18	25-35
Bolt	Flywheel Housing to Cylinder Block	3/8 -16	45-60
Spec. Ball	Clutch Equalizer Ball to Release Shaft	7/16-20	60-85
Bolt	Rear Mounting Pad to Transmission	7/16-14	50-60
Stud	Clutch Equalizer to Bracket to Frame	1/2 -13	20-30
Bolt	Transmission to Flywheel Housing	7/16-14	40-45

b. Clutch Specifications

Clutch Type	Single Plate-Dry Disc
Clutch Pedal Pressure	28-32 Lbs.
Clutch Pedal Lash	7/8" - 1 1/8"
Driven Plate Diameter	11" x 6 1/2"
Driven Plate Facings -	
Type and Number	Woven Molded, 2
Attachment to Plate	Rivets
Facing Thickness	.135 ± .002"
Total Effective Area (sq. in.)	61.85
Max. Allowable Run-out at Rear Face of Plate	.025"
Clutch Springs -	
Type and Number	Coil, 8
Total Pressure (lbs.)	1839
Spring Pressure (lbs.) @ Length	6 Springs 227 ± 5 lbs. @ 1.736 3 Springs 159 ± 5 lbs. @ 1.736
Free Length	Approx. 2 5/8"
Press. Plate Driving Lug Clearance in Cover	.005" - .008"
Height, Inner Ends of Release Levers to Flywheel	2.062
Max. Allowable Variation	.030"

4-8 DESCRIPTION OF CLUTCH

A single plate, dry disc clutch is used in Models equipped with synchromesh transmissions. The clutch is of conventional design with coil type clutch springs and three release levers. The release levers are adjustable.

a. Clutch Assembly

The clutch cover is bolted to the flywheel and three lugs on the pressure plate engage slots in the cover to transmit torque to the plate. Eight clutch springs are located between the cover and the pressure plate. The three clutch release levers are located so that their inner ends are in position to be engaged by the clutch release bearing. The levers pivot on fulcrums bolted to the clutch cover and in the three pressure plate lugs. See Figure 4-1.

The outer ends of the release levers are weighted so that at higher engine speeds where slipping is liable to occur, centrifugal force causes more pressure to be applied on the pressure plate. The faster the clutch revolves, the greater the pressure exerted against the clutch plate, thereby increasing the torque transmitting ability of the clutch. This additional pressure allows the use of a clutch which requires lower foot pressure at the pedal for normal clutch operation.

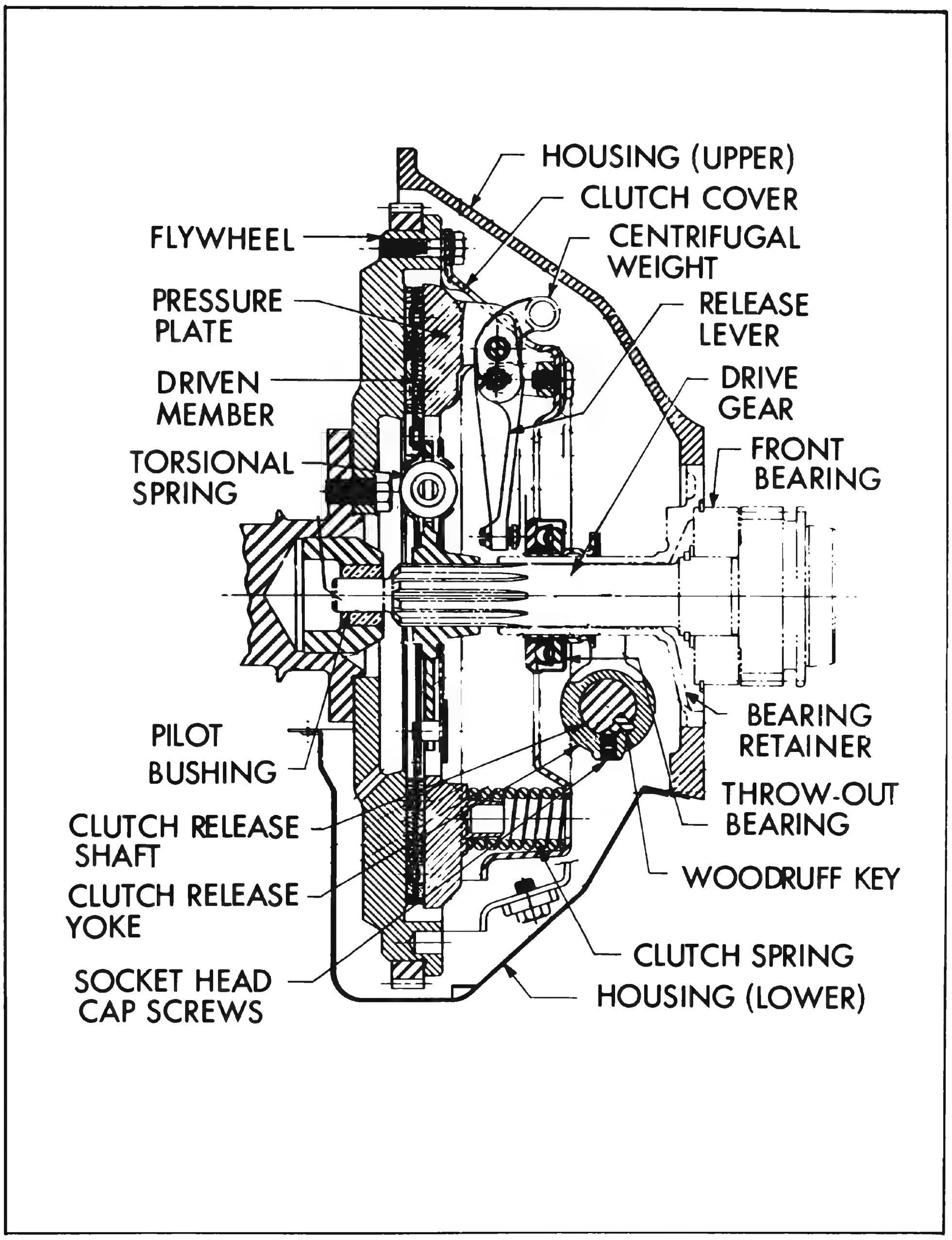


Figure 4-7—Clutch and Flywheel Assembly

When the clutch is in the engaged position, the release levers are clear of the release bearing and the clutch springs cause the pressure plate to clamp the driven plate against the flywheel with sufficient force to transmit power of the engine without slippage. The power drive is from flywheel to clutch cover, cover to pressure plate, and from pressure plate and flywheel to driven plate.

When the clutch is disengaged, the clutch release bearing presses forward on the inner ends of the release levers which pivot and force the pressure plate rearward against the pressure of clutch springs. The pressure plate is moved rearward far enough to free the driven plate. See Figure 4-1.

b. Clutch Driven Plate

The clutch driven plate assembly is mounted with a free sliding fit on the transmission main drive gear and is keyed to the gear by ten splines. The front end of the main drive gear is piloted by a bushing pressed into a recess in the rear end of the engine crankshaft. See Figure 4-1.

The outer area of the driven plate is divided into segments which are formed in low waves to provide springs between the plate facings and thereby cushion engagement of the clutch. A molded facing, grooved to give release,

is riveted to each side of every segment of the plate. When the clutch is fully released, the waved segments cause the facings to spread approximately .055" and the movement of pressure plate provides an additional clearance of approximately .030" to assure full release of driven plate. See Figure 4-2.

The driven plate assembly is designed to prevent torsional periods of the engine from being transmitted to the transmission gears and causing rattle. This is accomplished by driving the plate hub through torsional coil springs and providing frictional dampening by means of molded friction washers.

c. Clutch Linkage

The clutch pedal is of the suspended type and pivots on a shaft which extends through the clutch pedal bracket. The clutch pedal returns against a non-adjustable pedal stop on the bracket assembly.

The pedal rod extends through the floor pan to connect the pedal linkage to the clutch equalizer. The equalizer pivots between a ball stud located at the upper flywheel housing at one end and the frame at the other.

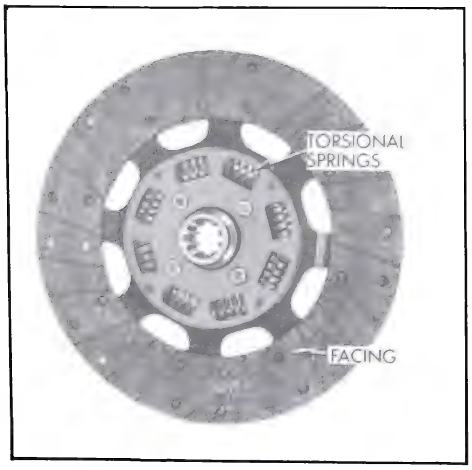


Figure 4-8—Driven Plate - Transmission Side

A heavy overcenter spring is stretched between an eye-bolt, which is anchored through the cowl at one end, and the clutch linkage at the other.

The upper clutch release rod is fastened to the clutch release lever (see Figure 4-3). The lower end of the release rod is fastened to the clutch equalizer with a clevis and retainer. Clutch adjustment is obtained on the lower clutch release rod.

The clutch release shaft pivots in the upper flywheel housing (see Figure 4-4). The clutch release shaft is retained in the upper flywheel housing by the clutch release lever and clutch equalizer (see Figure 4-4).

The clutch release yoke is positioned to push forward on the throw-out bearing when the clutch pedal is depressed. A U-shaped spring riveted to the throw-out bearing holds the throw-out bearing in contact with the clutch release yoke. The clutch release rod length must be adjusted to provide clearance between the throw-out bearing and the clutch release levers.

The throw-out bearing is mounted over the front bearing retainer which retains the transmission main drive gear bearing. The throw-out bearing is filled with lifetime lubricant in production and no further lubrication is required. Lightly lubricate inside diameter of throw-out bearing with wheel bearing lubricant or a heavy grease before installing.

4-9 CLUTCH TROUBLE DIAGNOSIS

a. Excessive Pedal Pressure

The pressure required to depress clutch pedal to toe board should not exceed 32 pounds. If pedal pressure is excessive, make certain that pedal rod is not binding where it passes through the cowl. Thoroughly lubricate equalizer with chassis lubricant. Lubricate all linkage pins with engine oil. If excessive pedal pressure still exists after release linkage is properly lubricated, lubricate internal working parts of clutch as described in paragraph 4-5.

b. Clutch Noise

Squeaking and grind noises during clutch pedal operation are usually caused by heavy friction in the release linkage or internal parts of clutch assembly. Before condemning the throw-out bearing, thoroughly lubricate equalizer and, if necessary, lubricate internal working parts of clutch as described in paragraph 4-5.

c. Clutch Grab or Chatter

A very slight amount of oil on driven plate facings will cause clutch grab and chatter. A new driven plate must be installed if original plate facings contain oil since removal of oil from facings is not practical.

When oil is found on facings, examine pilot bushing, transmission drainback, rear engine bearing, and oil leaks which might drain back into clutch housing between upper and lower flywheel housings.

d. Clutch Drag or Failure to Release

To test for clutch drag or failure to release depress clutch pedal to toeboard and put into low gear. Hold pedal depressed and shift transmission to neutral, wait about 15 seconds with pedal depressed and again shift into low gear. If clutch is not releasing completely a gear clash will occur.

If test shows that clutch is not releasing properly, check clutch pedal lash (par. 4-4) and check release linkage for lost motion. Correct as necessary and again test for clutch drag.

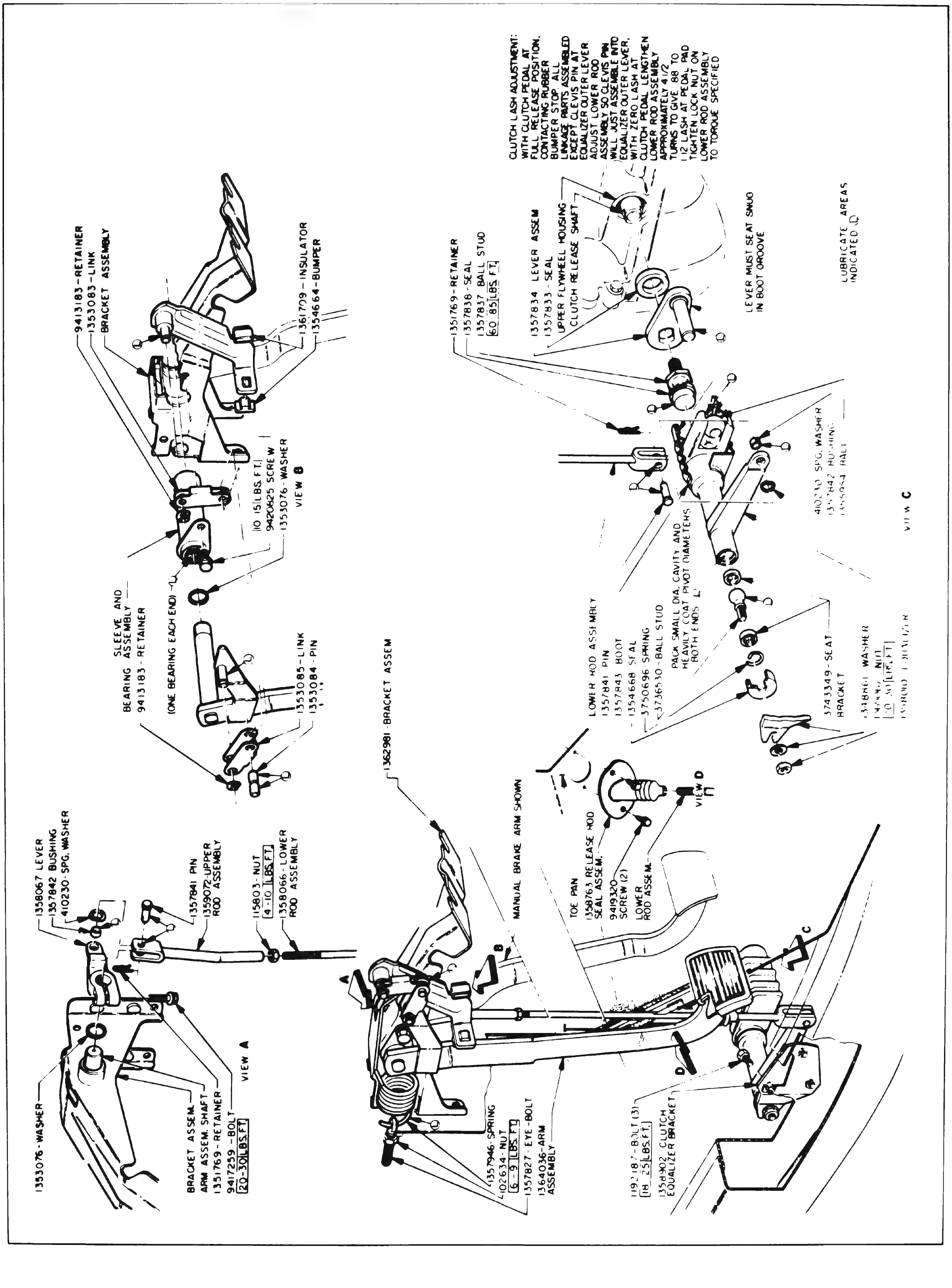


Figure 4-9—Clutch Linkage

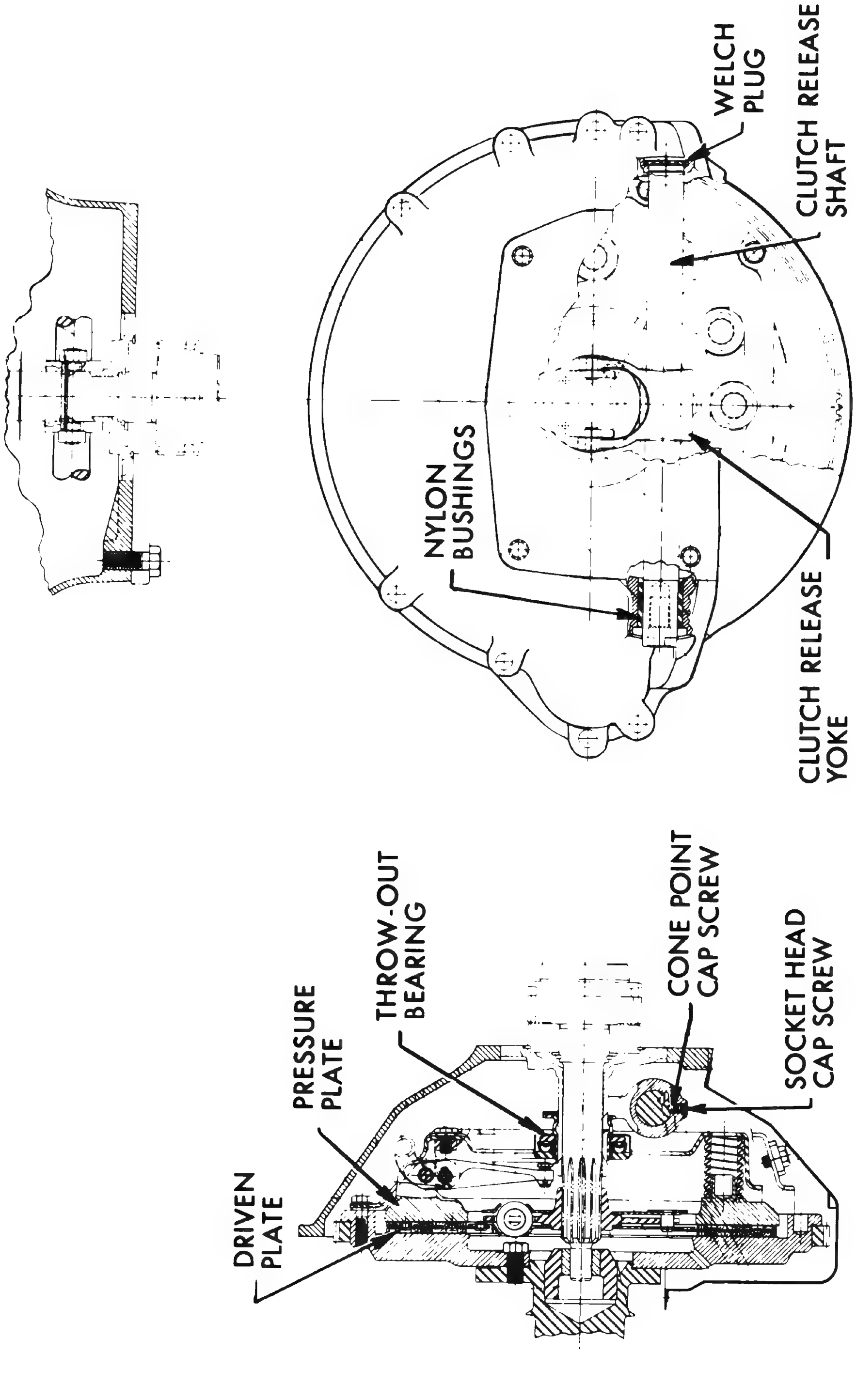


Figure 4-10—Clutch Information Assembly

If clutch drag cannot be corrected in release linkage, remove clutch and check height of release levers. Check driven plate for oil soaked or cracked facings, also for run-out and free movement on main drive gear (par. 4-6).

e. Clutch Slipping

First make certain that clutch pedal is adjusted for specified lash (7/8" to 1") and that pedal is not binding. One type of clutch slippage is sometimes wrongly diagnosed as due to weak clutch springs. This slippage occurs during gear shifting and full engagement of the clutch is not obtainable until the engine speed is reduced. After full engagement is obtained no further slippage occurs during acceleration or under full load. This condition is usually due to the clutch driven plate hub sticking on the splines of the transmission main drive gear. Correction can be made by removing the clutch and thoroughly cleaning splines of driven plate and main drive gear then applying a light coating of Lubriplate. Make sure that release lever pins are not binding, and that pressure plate driving lugs are not binding in clutch cover.

4-10 CLUTCH ADJUSTMENT

Pedal lash (free pedal) must be adjusted occasionally to compensate for normal wear of clutch facings. As the driven plate wears thinner, pedal lash decreases.

It is very important to maintain pedal lash at all times. Insufficient pedal lash will cause the throw-out bearing to ride against the release levers all of the time, resulting in abnormal wear of these parts. It may also cause clutch slippage and abnormal wear of the driven plate, flywheel, and pressure plate if pressure on the release levers is enough to prevent positive engagement of the clutch.

Check pedal lash (free pedal) by pushing on the pedal pad with the hand. Pedal lash should be 7/8" to 1" measured at the pedal pad.

Adjust pedal lash as follows:

1. Make certain that clutch pedal returns firmly against pedal bumper when pedal is released. If pedal does not contact bumper, check pedal and linkage for binding or lack of lubrication. See Figure 4-3.

2. With car raised, lift outer end of clutch equalizer until throw-out bearing contacts clutch release levers. Free movement at outer end of equalizer should be approximately 3/16". This should give correct lash at pedal.

3. If free movement is not about 3/16", remove clevis pin from bottom end of clutch release rod and rotate rod as required to make free movement correct. Reinstall clevis pin with new cotter pin.

4. Check to make sure pedal lash is between 7/8" and 1".

4-11 REMOVAL, LUBRICATION AND INSTALLATION OF CLUTCH

a. Removal of Clutch

1. Remove propeller shaft from front companion flange.

2. Remove transmission as described in paragraph 4-13.

3. Remove clutch equalizer shaft.

4. Disconnect clutch return spring.

5. Remove ball stud from clutch release shaft.

6. Remove clutch release lever.

7. Remove clutch release seal (see Figure 4-4).

8. Remove nylon bushing (see Figure 4-4).

9. Remove socket head cap screw on clutch release shaft. From same hole remove second socket head (cone point).

10. Pull clutch release shaft out approximately three (3) inches. Slide release yoke and throw-out bearing off end of release shaft. Remove release shaft.

11. Mark clutch cover and flywheel with a center punch so that cover can be reinstalled in the same position on flywheel in order to preserve engine balance.

12. Loosen each clutch cover bolt a turn at a time in order to relieve clutch spring pressure evenly and thereby avoid distortion of the cover. Metal spacers (such as 1/4" nuts) placed between release levers and inner edge of clutch cover will aid remove and later reinstallation by holding clutch springs partially compressed.

13. Support pressure plate and cover assembly while removing last bolts then remove the cover assembly and driven plate.

b. Lubrication of Clutch

Lubrication of the clutch release equalizer is required only when the clutch is overhauled; if lubrication becomes necessary between overhauls to eliminate squeaks or excessive pedal pressure, the clutch must be removed from the car.

1. Very sparingly apply wheel bearing lubricant in pilot bushing in crankshaft. If too much lubricant is used, it will run out on face of flywheel when hot and ruin driven plate facings. Make sure that surface of flywheel is clean and dry.

2. Make sure that splines in driven plate hub are clean and apply a light coat of Lubriplate. Apply a light coat of Lubriplate on

transmission drive gear splines. Slide driven plate over transmission drive gear several times. Remove driven plate and wipe off all excess lubricant pushed-up by hub of plate. Driven plate facings must be kept clean and dry.

3. Coat diameter of throw-out bearing with wheel bearing lubricant. Make sure transmission front bearing retainer sleeve is clean and apply a light coat of wheel bearing lubricant. Slide throw-out bearing over transmission retainer several times. Remove throw-out bearing and wipe off all excess lubricant pushed up by hub of bearing.

4. If clutch pressure plate driving lugs are dry, brush a little Lubriplate in between clutch cover and driving lugs, also between driving lugs and release levers. Wipe off any excess lubricant.

c. Checking Release Lever Height

Correct release lever height is essential to insure complete release of the clutch and also to allow smooth, positive engagement of the clutch. Before reinstalling a clutch pressure plate and cover assembly, release lever height should be checked as follows:

1. Mount clutch assembly for checking by placing Adjusting Gauge J-1036 on a spare flywheel and then placing clutch assembly over gauge so that release levers are directly above machined bosses of gauge. See Figure 4-5.

NOTE: Thickness of gauge at machined bosses is .295"; height of gauge at hub is 2-1/16".

2. Install cover bolts and tighten each a turn at a time until all are uniformly tight.

3. Zero dial indicator by mounting dial indicator on Support J-1013. See Figure 4-5. Then set support on flat surface, press indicator down against surface until indicator hand turns approximately one revolution, and tighten indicator to support. Now set indicator face to zero.

Figure 4-11—Checking Release Lever Height

4. To measure release lever height, carefully place support and indicator on hub of gauge so that indicator stem bears on inner end of each release lever in turn. Indicator hand must turn one revolution and then read within plus or minus .031". Also, all three levers must read within .031" of each other.

5. If release lever heights are not within these specifications, adjust levers as described in subparagraph below.

d. Adjusting Release Lever Height

When any release lever height varies over .031" from the height of the gauge hub, or when the highest and lowest release lever are not within .031" of each other, release lever height must be adjusted.

1. Check tightness of three release lever yoke bolts by tightening to 25 foot pounds.

2. Check release lever height as described in subparagraph above. If any one lever is not within specifications, it is recommended that all three levers be adjusted.

3. Turn each adjusting screw up or down as required to give a dial indicator reading of zero. (Any free movement or "play" should be removed by holding lever downward.)

4. Remove clutch assembly from spare flywheel by loosening cover bolts a turn at a time until metal

spacers are pinched between clutch levers and inner edge of clutch cover. A string or wire fastened to each spacer will keep it from dropping inside the clutch assembly during installation on the car.

5. Turn clutch assembly over so that pressure plate side is up and adjusting screw buttons are contacting a solid surface.

6. Stake each adjusting screw to release lever by peening release lever material into adjusting screw slot at both sides. A blunt screwdriver which nearly fills the slot may be used.

e. Installation of Clutch

1. Place driven plate on pressure plate with raised torsional spring part projecting into center of pressure plate, then place driven plate and pressure plate assembly in position against flywheel. Be sure to align marks on clutch cover with marks on flywheel. Install cover bolts and lockwashers, but do not tighten bolts yet.

2. Insert a spare main drive gear through hub of driven plate and into pilot bushing. Tighten each clutch cover bolt one turn at a time to draw cover down evenly and avoid distortion of cover. While tightening cover bolts, move main driven gear from side to side to center driven plate with pilot bushing. If plate is not properly centered, it will be very difficult to slide transmission into place. Make sure all cover bolts are tightened securely.

3. Remove three spacers from between clutch cover and release levers, if used.

4. Install clutch release shaft part way into upper flywheel housing and install woodruff key into shaft.

5. Slide clutch release yoke onto shaft and slide shaft into place. CAUTION: Make sure release yoke is installed so cone pointed cap screw can be installed into counter bore on shaft. (See Figure 4-4).

6. Install clutch release yoke over woodruff key. Install cone point socket head cap screw first. Install second socket head cap screw in same hole. (See Figure 4-4).

7. Install nylon bushing

8. Install clutch release seal.

9. Install clutch release lever.

10. Install ball stud to clutch release shaft.

11. Install clutch equalizer shaft.

12. Install clutch release rod with retainer pin. Adjust clutch pedal lash as described in paragraph 4-4.

13. Install transmission as described in paragraph 4-12. Be sure to use guide pins to avoid damage to clutch driven plate.

14. Install flywheel lower housing.

15. Road test car for clutch performance. Under no circumstance should the clutch be harshly used immediately after installation of a new driven plate, flywheel, or pressure plate. Sudden engagement of clutch with engine running at abnormal speed, or continual slipping of clutch, may permanently injure driven plate facings and may cause scoring of flywheel and pressure plate. When these parts are new they must be given moderate use for several days until nicely burnished. Be sure that car owner is advised of this requirement.

4-12 INSPECTION OF CLUTCH

Wash all metal parts of clutch, except release bearing and driven plate, in suitable cleaning solution to remove dirt and grease. Soaking release bearing in cleaning solution would permit solution to seep into bearing and destroy the lubricant. Soaking driven plate in cleaning solution would damage the facings.

1. Flywheel and Pressure Plate. Examine friction surfaces of flywheel and pressure plate for scoring and roughness. Slight roughness may be smoothed with fine emery cloth, but if surface is deeply scored or grooved the part should be replaced.

2. Clutch Cover. Inspect clutch cover for cracks or distortion. Check clearance between pressure plate driving lugs and edges of slots in cover, using feeler gauges. The clearance should be .005" to .008"; excessive clearance may cause rattle when engine is intermittently accelerated with clutch disengaged.

3. Clutch Driven Plate. Inspect driven plate for condition of facings, loose rivets, broken or very loose torsional springs, and flattened cushion springs. See Figure 4-2.

If facings are worn down near rivets or are oily, the plate assembly should be replaced. A very slight amount of oil on clutch facings will cause clutch grab and chatter. A large amount of oil on facings will cause slippage. Removal of oil by solvents or by buffing is not practical since oil will continue to bleed from facing material when hot.

When oil is found on driven plate facings, examine transmission drainback hole, pilot bushing, engine rear main bearing and other points of oil leakage.

Test the fit of driven plate hub on transmission main drive gear; an easy sliding fit should exist. Regardless of whether the old plate or a new one is to be installed, the plate should be checked for run-out. This check can be made by sliding the driven plate, front side first, over the transmission main drive gear until it is tight on the spline, then setting up a dial indicator to bear against the plate facing as shown in Figure 4-6. While holding firmly against front end of main drive gear to take up play in main drive gear bearing, slowly rotate driven plate and observe the amount of run-out shown by indicator. If run-out of front facing exceeds .025" the plate should not be used since it is not practical to correct excessive run-out by bending.

4. Bearings. Inspect clutch release bearing for scoring or excessive wear on front contact face. Test for roughness of balls and races by pressing and turning front race slowly. Inspect main drive gear pilot bushing in crankshaft. If bushing is rough or worn it should be replaced.

4-13 ALIGNMENT OF FLYWHEEL UPPER HOUSING

The flywheel upper housing which joins the synchromesh transmission to the engine crankcase is attached to the crankcase by bolts, with two straight dowels to maintain alignment.

Misalignment between the pilot hole which receives the main drive gear bearing in rear wall of housing and the pilot bushing in rear end of crankshaft may cause the transmission to be noisy or to slip out of high gear. To insure correct alignment in production, the pilot hole is bored in the housing after it is assembled to the cylinder crankcase. The flywheel housing furnished for service is completely machined, but it must be checked for alignment after installation.

If an existing housing is suspected of being out of alignment it may be checked after removal of the transmission and clutch assemblies. If a new housing or cylinder crankcase is being installed, alignment should be checked before the flywheel, clutch and transmission are installed. When checking alignment the engine must be in an upright position, dowel pins must be installed, and all housing bolts must be tight.

a. Checking Alignment of Flywheel Upper Housing

1. Remove transmission (par. 4-5) and clutch, leaving flywheel in place.

2. Attach Indicator Support J-4710-1 to flywheel with two flywheel bolts. Mount dial indicator and hole attachment on pilot as shown in Figure 4-16. Adjust ball end of hole attachment to bear against side of pilot hole in flywheel housing.

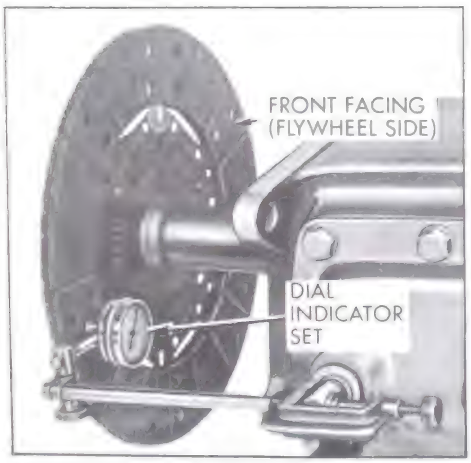


Figure 4-12—Checking Driven Plate for Run-Out

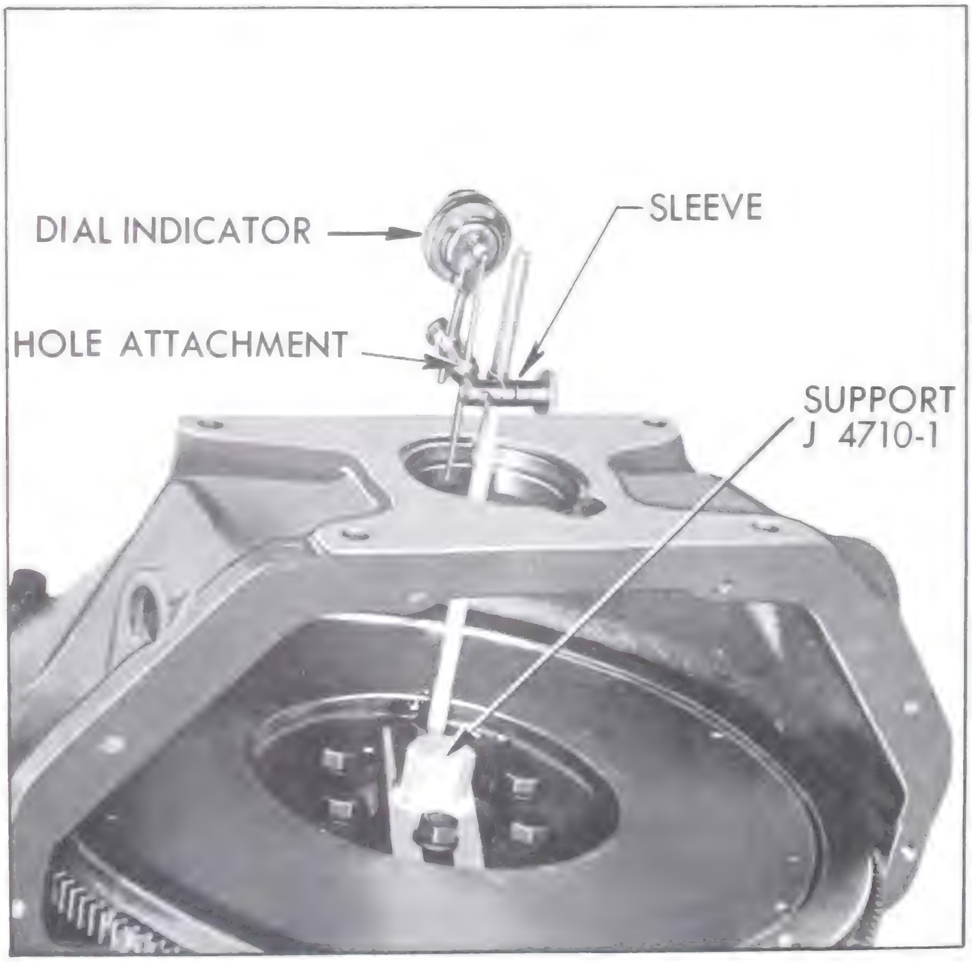


Figure 4-13—Checking Alignment of Housing at Pilot Hole

3. Turn flywheel very slowly and note total run-out of pilot hole as shown by dial indicator. If total indicator reading is .005" or less, flywheel housing alignment is satisfactory. If run-out exceeds .005", correction must be made as follows:

b. Correction of Flywheel Upper Housing Misalignment

1. Remove flywheel upper housing and dowel pins from crankcase.

2. Drill out bolt holes in flywheel housing with a 1/2" drill.

3. Install flywheel housing without dowel pins, and leave bolts just loose enough to permit shifting of housing by tapping with lead hammer.

4. Install dial indicator as shown in Figure 4-16, and check run-out at pilot hole in housing.

5. Shift housing by tapping with lead hammer as required to bring run-out at pilot hole within .003" indicator reading. Tighten housing bolts and re-check run-out.

6. Using Special Reamer J 2548-3 and Ratchet Wrench J 808-6, ream the dowel holes and install two oversize dowel pins J 808-5.

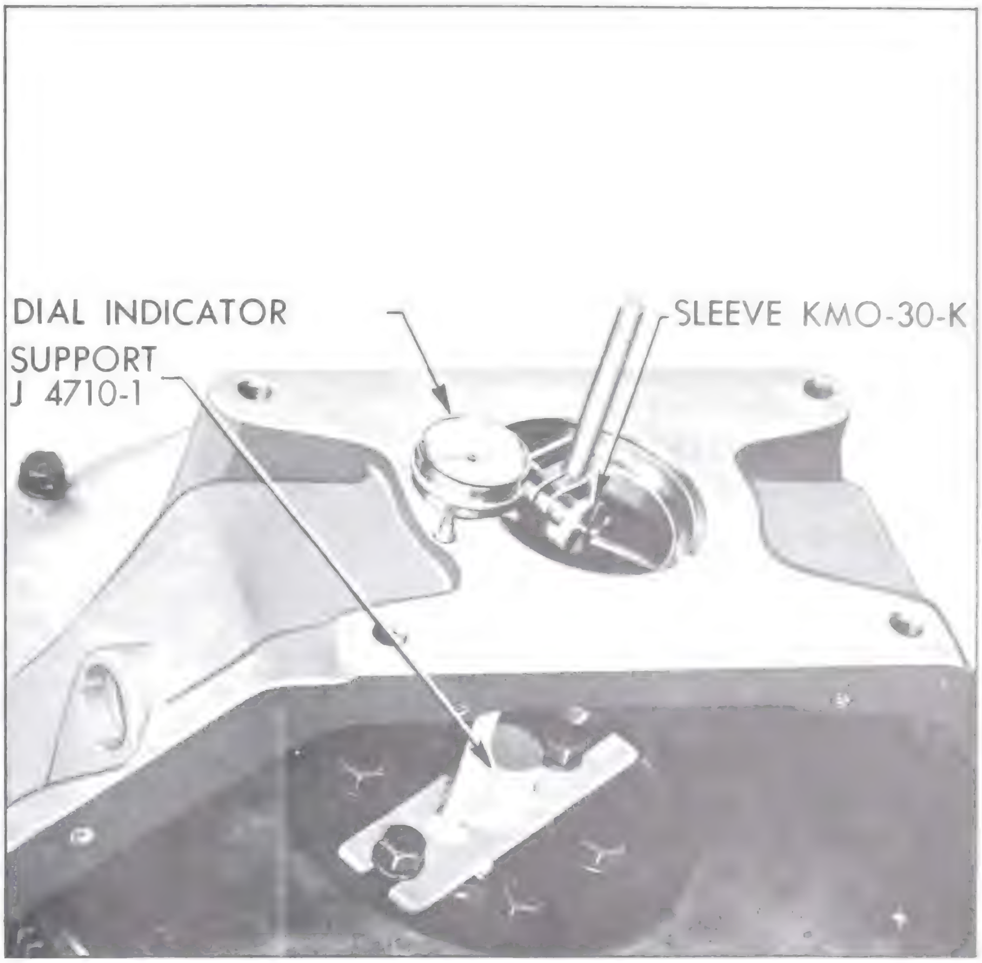


Figure 4-14—Checking Run-Out of Rear Face of Housing

7. Mount dial indicator to bear against rear face of flywheel housing at a radius of 2 1/2", as shown in Figure 4-8.

8. Turn crankshaft and note run-out of housing rear face, making sure that end thrust of crankshaft is all one way while making this check. If total indicator reading exceeds .003", check for dirt or burrs between housing and crankcase.

9. If no dirt or burrs are present, cement paper shims of proper thickness to crankcase in position required to give an indicator reading of .003" or less, when all bolts are securely tightened.

10. Install clutch and transmission (par. 4-5).

4-C

3-SPEED SYNCHROMESH—4400

CONTENTS OF SECTION 4-C

NOTE: 3-Speed synchromesh transmission is standard equipment on Series 4400.

4-15 S-M TRANSMISSION SPECIFICATIONS

a. Bolt Tightening Specifications

Location	Thread Size	Torque Ft. Lbs.
Side Cover Retaining Bolt (Use with 5/16 heavy lock washer)	5/16-18 x 7/8	15-18
Clutch Gear Bearing Retainer Bolt (Use with 5/16 internal tooth lock washer)	5/16-18 x 3/4	10-12
Transmission Rear Extension Retaining Bolt (Use with 7/16 external tooth lock washer)	7/16-14 x 1 1/8	40-45

b. Transmission Specifications

Type	3-Speed Manual Shift Synchromesh
Mounting	Unit with Engine
Lubricant	
Type	SAE 90 Transmission Multi-Purpose
Capacity	2 Pints
Type of Gearing	All Helical
Synchronization	2nd and 3rd Gears
Constant Mesh Gears	2nd Gear
Sliding Gears	1st and Reverse Gears
Gear Ratios	
1st	2.58:1
2nd	1.48:1
3rd	1.00:1
Reverse	2.58:1
Gear Shifting	Remote, on Steering Column

c. Speedometer Gears

Speedometer Driving Gear (on Mainshaft)	Press Fit
Driving Gear Teeth	
3.07 Ratio Rear Axle	9
3.23 Ratio Rear Axle	9
3.33 Ratio Rear Axle	8

	Tire Size	
	7.10 x 15	7.60 x 15
Driven Gear Teeth		
3.07 Ratio Rear Axle	18	20
3.23 Ratio Rear Axle	21	21
3.36 Ratio Rear Axle	20	19

4-16 S-M TRANSMISSION DESCRIPTION

The synchromesh transmission is solidly bolted to the rear face of the upper flywheel housing, forming a unit assembly with the engine. The clutch gear bearing retainer projects into a bore in the flywheel housing, serving as a pilot to center the transmission with the engine crankshaft.

a. Transmission Gears and Shafts

The clutch gear extends through the clutch driven plate into an oil impregnated bronze bushing in the rear of the engine crankshaft. The rear of the clutch gear is supported by a ball bearing in the front of the transmission case. The inner race of the bearing is a press fit on the clutch gear shaft. The outer race is grooved for a snap ring that fits between the transmission case and the front bearing retainer to hold the bearing and clutch gear in place.

The front end of the mainshaft is piloted in a double set of roller bearings set into the hollow end of the clutch gear, while the rear end is supported by the transmission rear bearing and is a slip fit in the front end of the transmission rear extension. The outer race is grooved for a snap ring which retains the race in the rear extension. The inner race is a press fit on the mainshaft. The bearing is prevented from moving forward by the second speed gear thrust washer, and retained at the rear by a snap ring fitted into a groove on the mainshaft.

The countergear is carried on roller bearings at both ends, while thrust is taken on washers located between each end of the gear and the case.

A hole in the hub of the countergear permits lubricant to reach the bearings and thrust washers. The reverse idler gear is carried on ball indented bronze bushings. Forward thrust of the gear is taken on a washer located between the front of the gear and the case, while rearward thrust is taken on a radial needle bearing and a washer located between the rear of the gear and the case. The reverse idler gear shaft is held in position by a pin passing through the case into the rear end of the shaft.

The second gear is mounted on the mainshaft in such a position that it is constantly in mesh with the countergear. The gear is free to rotate on the mainshaft except when engaged by the synchronizing assembly during second speed operation.

The first-reverse sliding gear is splined to the second-third speed clutch so that it can be moved forward to engage the countergear for first speed or rearward to engage the reverse idler for reverse.

b. Gear Shifting and Synchronization

1. Gear Shifting - Shifter forks extending through the transmission side cover constitute the gear change mechanism. The forward lever moves the clutch sleeve forward or rearward to provide synchronized 2nd and 3rd speeds. The rear lever moves the sliding ring gear forward or rearward to engage the countergear for 1st and reverse speeds. A shift interlock prevents both levers from moving at the same time. One lever must be in neutral position before the other will function.

2. Synchronization

Gear shift synchronization is provided in 2nd and 3rd speeds by a clutch sleeve with one synchronizing ring at each end. The front ring is positioned over the drive splines of the main drive gear. The rear ring is positioned over the splines of the second speed gear. 4 lugs on the rings fit into slots in their respective gears, causing the rings to rotate when the gear rotates. This arrangement allows the ring to slide on the gear. An energizing spring, positioned in a groove on the gear, provides resistance to this movement. As the clutch sleeve is slid forward or rearward, the beveled outer diameter of the ring contacts the beveled inner diameter of the clutch sleeve. The ring, which is rotating at the same speed as the gear, causes the sleeve to rotate at the same speed the gear is rotating. Further movement of the sleeve forces the lugs of the synchronizing ring over the energizing spring on the gear. This resistance to movement of the ring, causes a more positive contact between the sleeve and the ring. Thus, the sleeve and ring rotate at the same speed. Still further movement of the sleeve allows the internal drive splines of the sleeve to mesh with the external drive splines of the gear. This provides a positive engagement of the sleeve with the gear. Since the clutch sleeve is splined to the mainshaft, the gear is "locked" to the mainshaft.

c. Speedometer Gears

The speedometer driving gear is a press fit on the mainshaft. Normally, when changing rear axle ratios it is unnecessary to change the driving gear. However, with certain ratios, changing the driving gear becomes necessary. See Figure 4-27.

The driven gear and shaft is held in the rear extension by a fitting, lockplate, lock washer, and bolt. An "O" ring provides a seal between the driven gear assembly and the rear extension.

d. Power Flow Thru Transmission

1. <u>First Gear - Mechanical Action</u> - The shifter fork slides

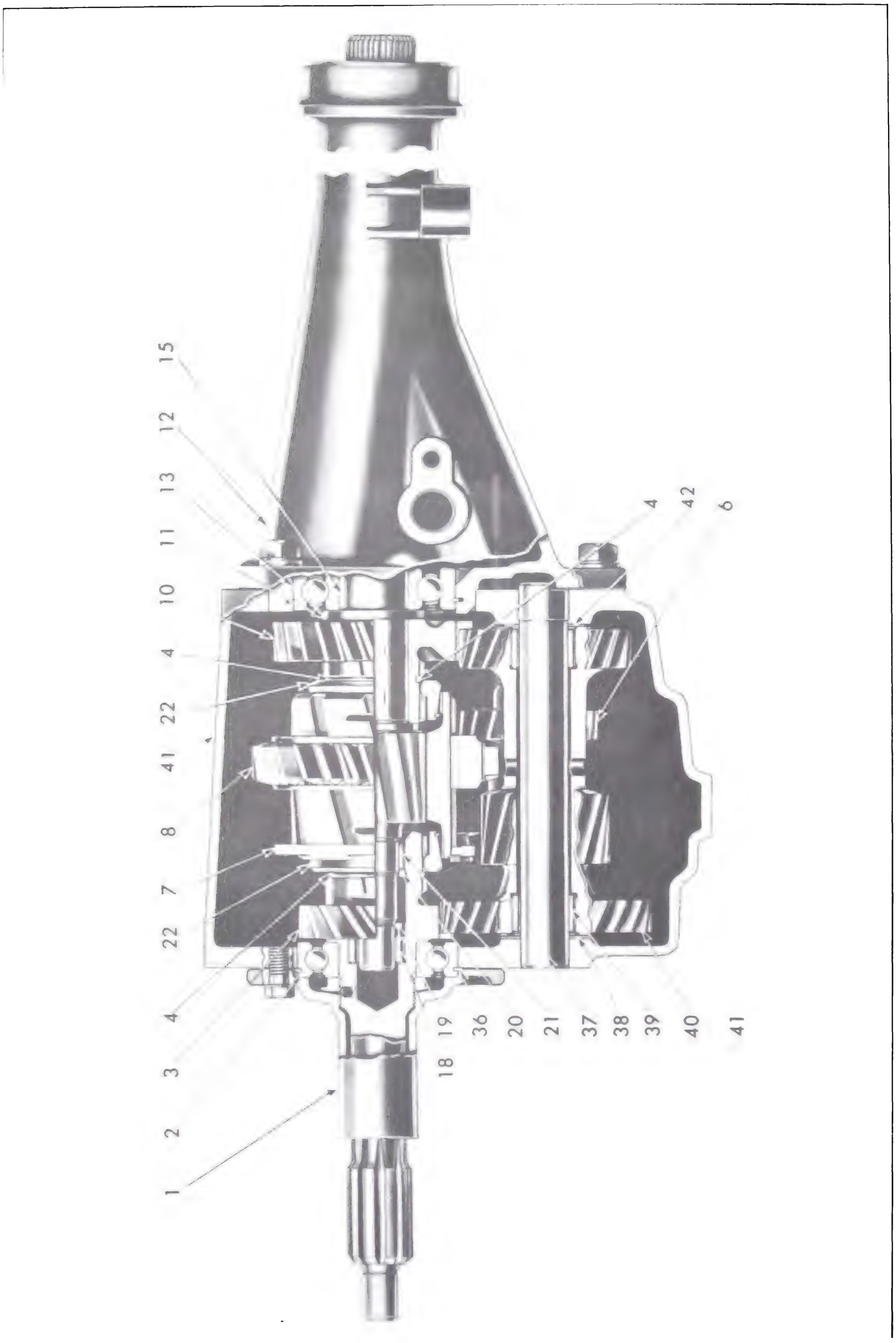


Figure 4-16A—Transmission Cross-Section (Side View)

1. Clutch Gear Bearing Retainer
2. Clutch Gear Bearing
3. Clutch Gear
4. Energizing Spring
6. Reverse Idler Gear
7. Second and Third Speed Clutch
8. First and Reverse Sliding Gear
10. Second Speed Gear
11. Thrust Washer
12. Case Extension
13. Main Rear Bearing
15. Mainshaft
18. Front Pilot Bearing Rollers
19. Thrust Washer
20. Thrust Washer
21. Rear Pilot Bearing Rollers
22. Synchronizer Ring
36. Snap Ring
37. Countershaft
38. Thrust Washer
39. Roller Bearing
40. Countergear
41. Transmission Case
42. Roller Thrust Washer

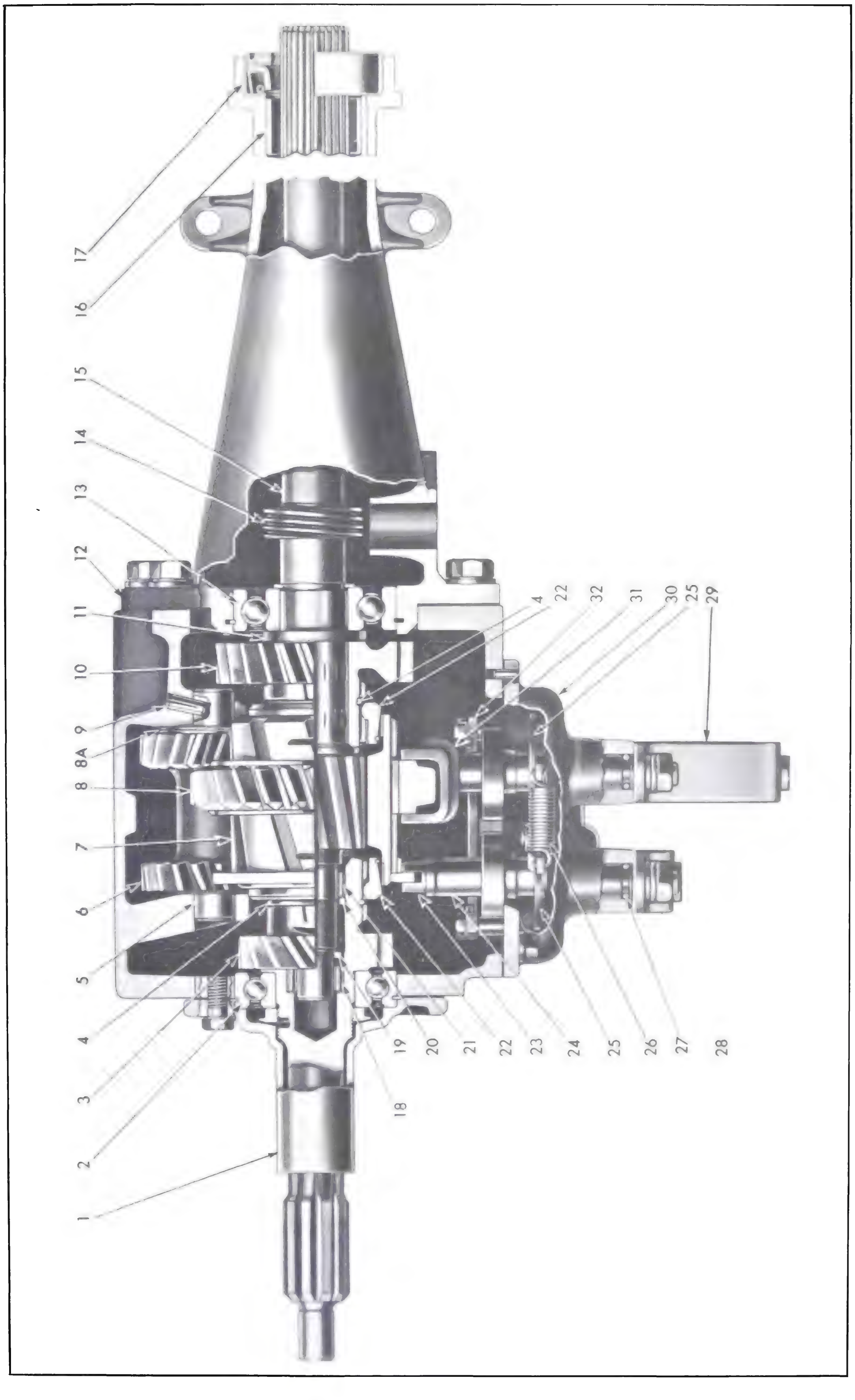
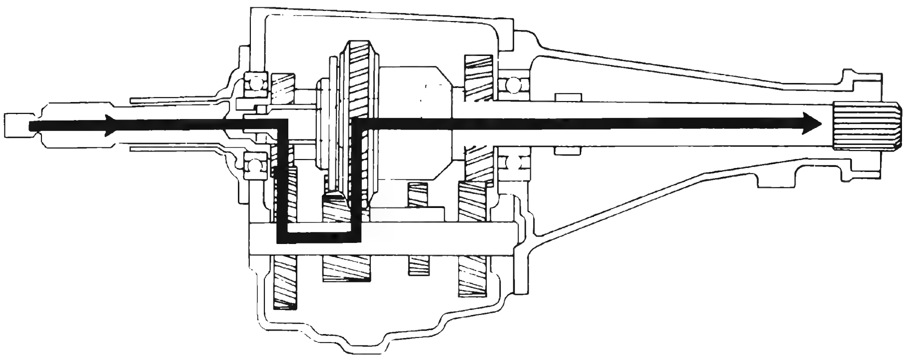
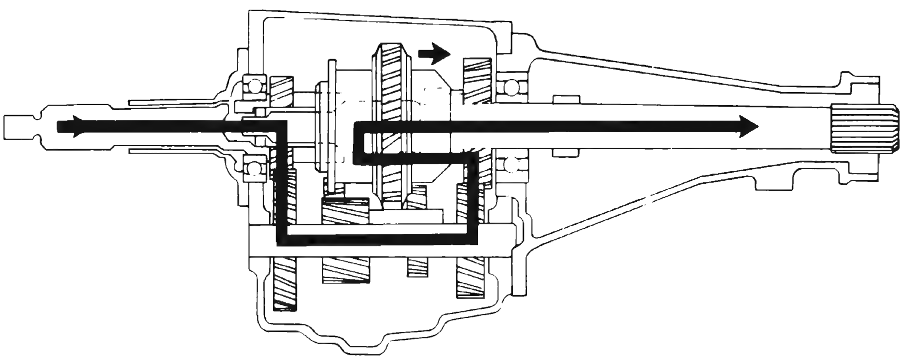


Figure 4-16B—Transmission Cross Section (Top View)

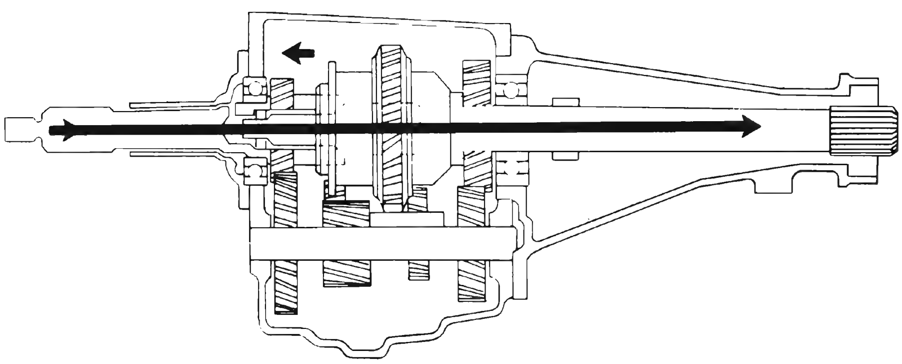
1. Clutch Gear Bearing Retainer
2. Clutch Gear Bearing
3. Clutch Gear
4. Energizing Spring
5. Reverse Idler Shaft
6. Reverse Idler Gear
7. Second and Third Speed Clutch
8. First and Reverse Sliding Gear
8a. Thrust Bearing and Washer
9. Reverse Idler Shaft Pin
10. Second Speed Gear
11. Thrust Washer
12. Case Extension
13. Mainshaft Rear Bearing
14. Speedometer Drive Gear
15. Mainshaft
16. Bushing
17. Oil Seal
18. Front Pilot Bearing Rollers
19. Thrust Washer
20. Thrust Washer
21. Rear Pilot Bearing Rollers
22. Synchronizer Ring
23. Second and Third Shifter Fork
24. Second and Third Shifter Shaft
25. Detent Cam
26. Detent Cam Spring
27. "O" Ring Oil Seal
28. Second and Third Shifter Lever
29. First and Reverse Shifter Lever
30. Slide Cover
31. First and Reverse Shifter Fork
32. Interlock Retainer



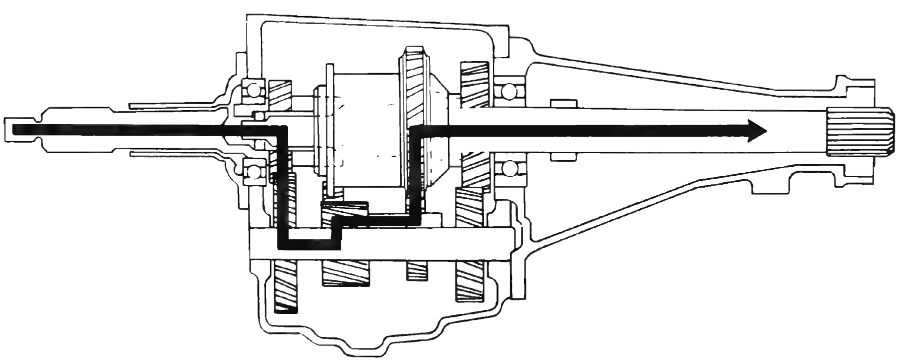
FIRST GEAR RATIO 2.58 TO 1



SECOND GEAR RATIO 1.48 TO 1



THIRD GEAR RATIO 1 TO 1



REVERSE GEAR RATIO 2.58 TO 1

Figure 4-17—Transmission Power Flow

the ring gear into contact with the middle gear on the countergear. The countergear is in constant mesh with the main drive gear.

First Gear - Power Flow - Torque is imparted to the countergear by the main drive gear. It is then transferred to the ring gear on the clutch sleeve by the middle gear on the countergear. The ring gear is splined to the clutch sleeve which, in turn, is splined to the mainshaft.

2. Second Gear - Mechanical Action - The ring gear is moved back to the neutral position and the clutch sleeve is moved rearward to engage the front part of the second speed gear. The second speed gear is in constant mesh with the rear of the countergear.

Second Gear - Power Flow - Torque imparted to the countershaft by the main drive gear is transmitted to the second speed gear. The second speed gear, now splined to the clutch sleeve, transmits torque to the mainshaft through the clutch sleeve.

3. 3rd or Direct Gear - Mechanical Action - The clutch sleeve is moved forward to engage the rear of the main drive gear. The ring gear remains in the neutral position. Thus the main drive gear is in contact with the mainshaft through the clutch sleeve.

3rd or Direct Gear - Power Flow - Torque imparted to the main drive gear is applied directly to the mainshaft through the clutch sleeve.

4. Reverse Gear - Mechanical Action - The shifter fork slides the ring gear rearward to engage the rear gear on the reverse idler gear. The forward gear of the idler gear is always in constant mesh with the middle gear on the countergear. The clutch sleeve is in the neutral position.

Reverse Gear - Power Flow - Torque imparted to the main drive gear is applied to the countergear. The middle gear on the counter, being in mesh with the idler gear, transmits the torque to the idler gear. The idler gear, in turn, is in mesh with the ring gear and transmits torque to it and the clutch sleeve to which the ring gear is splined. The clutch sleeve then turns the mainshaft.

4-17 S-M TRANSMISSION TROUBLE DIAGNOSIS

a. Hard Shifting and Block-out

Hard shifting may be caused either by conditions in the shift control mechanism or by conditions in the transmission assembly. Disconnect the shift rods at the control shaft levers to determine which is at fault.

b. Slipping or Jumping Out of Gear

In any case of gear jump-out or slippage, first check the adjustment of the gear shift control mechanism as described in Section 4-A.

Gear jump-out in any reduction gear could be caused by damaged teeth on mating gears or improperly mated splines on the inside of first and reverse gear and/or external spline on second and thrid speed clutch sleeve. Also a loose fit of the bearings and bushings involved can cause this condition.

Gear jump-out in third or direct speed can be caused by the following conditions:

(1) Transmission loose in clutch housing.

(2) Damaged mainshaft pilot bearing.

(3) Clutch gear bearing retainer broken or loose.

(4) Misalignment of transmission.

(5) Does not fully engage. Check length of engagement pattern on clutching teeth. If less than 7/64", check for misadjusted shift linkage.

c. Gear Clash

Transmission gears can be made to clash by shifting into first or reverse gear too quickly after the clutch pedal is depressed, even though clutch is in perfect working order. This is because inertia of the clutch driven plate, drive gear, and countergear causes these parts to spin until stopped by friction of the transmission and transmission lubricant. With warm transmission lubricant and low friction transmission bearings, a reasonable amount of spin is to be expected.

d. Noise in Neutral

With the car standing, engine running, and transmission in neutral, the transmission parts in operation are; main drive gear and bearing, countergear and bearings, reverse idler gear, second speed gear. Disengaging the clutch will stop movement of all these parts. By disengaging and engaging the clutch it can be determined whether the noise originates in these transmission parts and whether the noise is normal. Noise in neutral in the form of a constant regular click is usually caused by a nicked gear or bearing.

e. Gear Rattle During Acceleration

An improperly calibrated clut h driven plate, a faulty crankshaft balancer, or scored rear axle gears may cause rattle in the transmission in third speed on acceleration. Rattles occurring on wide open throttle between 40 and 60 MPH are usually caused by improper clutch driven plates dampening; a new driven plate should be installed if rattles are objectionable.

f. Scored or Broken Gear Teeth

Gear teeth will be seriously damaged and possibly broken by failure of the car operator to fully engage the gears on every shift before engaging the clutch and applying engine power.

Considerable damage to gears and bearings may result from running at abnormal speeds in reverse, first, and second speed gears. This practice is also detrimental to the engine.

The clash does not occur when shifting quickly into second or high gear with the car standing still because the synchronizer stops the spinning parts.

Therefore, sufficient time must be allowed before shifting into first after the clutch pedal is depressed.

g. Gear Noise

Some gear noise is to be expected in all except third speed. Comparison with another car is the only means of determining whether or not gear noise is excessive. Before removing the transmission for correction of gear noise, check the lubricant level, and add any if necessary. Then determine by test which gears are noisy under load, so that these parts can be thoroughly inspected when removed.

Shifting out of first or reverse very slowly will usually result in some noise just as the gears disengage. This is normal because of the gear pointing necessary for easy engagement.

Abnormal noise during a normally fast shift may be caused by improper clutch release. Check clutch pedal lash and adjust.

Abnormal noise during a normally fast shift, when clutch release is satisfactory, may be caused by damage to the pointing on the

engaging side of the teeth on the countergear, reverse idler gear or first - reverse sliding gear. Noise when disengaging both first and reverse indicates that the fault is with the sliding gear only. Noise when disengaging reverse only indicates that the reverse idler gear is at fault. Noise when disengaging first speed only indicates that the countergear is at fault. Tests must be made by disengaging gears while car is still in motion.

4-18 REMOVAL AND INSTALLATION OF TRANSMISSION

a. Removal From Vehicle

1. Drain lubricant from transmission.

2. Disconnect the speedometer cable from speedometer driven gear fitting and disconnect shift control rods and equalizer from the shifter levers at the transmission.

3. Remove propeller shaft as outlined in Group 6. Support rear of engine and remove transmission mounting block-to-support (cross member) bolts and washers. Remove support-to-frame bolts and washers and remove support.

4. Remove the 2 top transmission to clutch housing cap screws and insert 2 transmission guide pins, Tool J-1126, in these holes.

5. Remove the 2 lower transmission to clutch housing cap screws.

6. Slide the transmission straight back on guide pins until the clutch gear is free of splines in the clutch disc.

7. Remove transmission from under the body.

b. Installation in Vehicle

1. Install guide pin, Tool J-1126, in upper right transmission to clutch housing bolt hole for alignment and place transmission on guide pin. Rotate transmission as necessary and start clutch gear shaft into clutch disc and slide transmission forward.

2. Install the two lower transmission mounting bolts and lock washers and tighten securely. Remove guide pin and install upper mounting bolts and lock washers. Torque to 45-60 ft. lbs.

3. Position the transmission support under transmission mounting bracket. Install transmission support and support-to-mounting block bolts and washers.

4. Install propeller shaft as outlined in Group 6.

6. Remove speedometer driven gear and add 1/2 pint of transmission lubricant to housing. Install speedometer driven gear.

7. Connect speedometer cable to driven gear and tighten securely.

8. Fill transmission with lubricant.

c. Transmission Alignment

If transmission slips out of high gear, particularly at 50 MPH and above, and all other probable causes outlined in paragraph 4-9 have been eliminated, the alignment of the engine crankshaft pilot, clutch housing bore, and the transmission should be checked.

A special tool, on which is mounted a dial indicator, is necessary to check the transmission rear bearing bore alignment. This tool may be made from a new or good used clutch gear which has a good bearing surface on the crankshaft pilot and front main bearing. The splines on the clutch gear shaft should be ground in so the shaft may be rotated in the clutch disc hub without interference when assembled in the car. Weld a piece of 1/4" rod, 8" long, in the mainshaft pilot bore. Assemble a good bearing on the shaft and secure it with a clutch gear bearing nut.

1. Remove the transmission from the car and completely disassemble.

2. Install the case extension on the case and tighten the extension-to-case bolts securely.

3. Install the special tool with the dial indicator in the transmission case, with the face of the indicator and the tracing finger to the rear of the transmission. Secure in place with a clutch gear bearing retainer.

4. Rotate the gear and make final adjustment of the indicator with the tracing finger to the rear of the case and in the center of the rear bearing bore in the case extension.

5. Assemble the transmission case to the clutch housing and tighten the four transmission mounting bolts securely.

6. Install transmission support and support-to-transmission mounting block bolts.

7. Remove the jack or other support from under the engine and let the weight of the engine rest on the transmission mounting in the normal position.

8. With the dial indicator, check the readings of the rear bearing bore at the 12, 3, 6, and 9 o'clock positions.

9. Install temporary slotted shims between the transmission case and the clutch housing in the quantities and at the bolt locations as necessary to bring misalignment at the transmission rear bearing bore to a maximum of .010" indicator reading in either the horizontal or vertical plane.

NOTE: INSTALLATION OF A .002" SHIM BETWEEN THE TRANSMISSION CASE AND THE CLUTCH HOUSING AT TWO BOLT LOCATIONS OPPOSITE

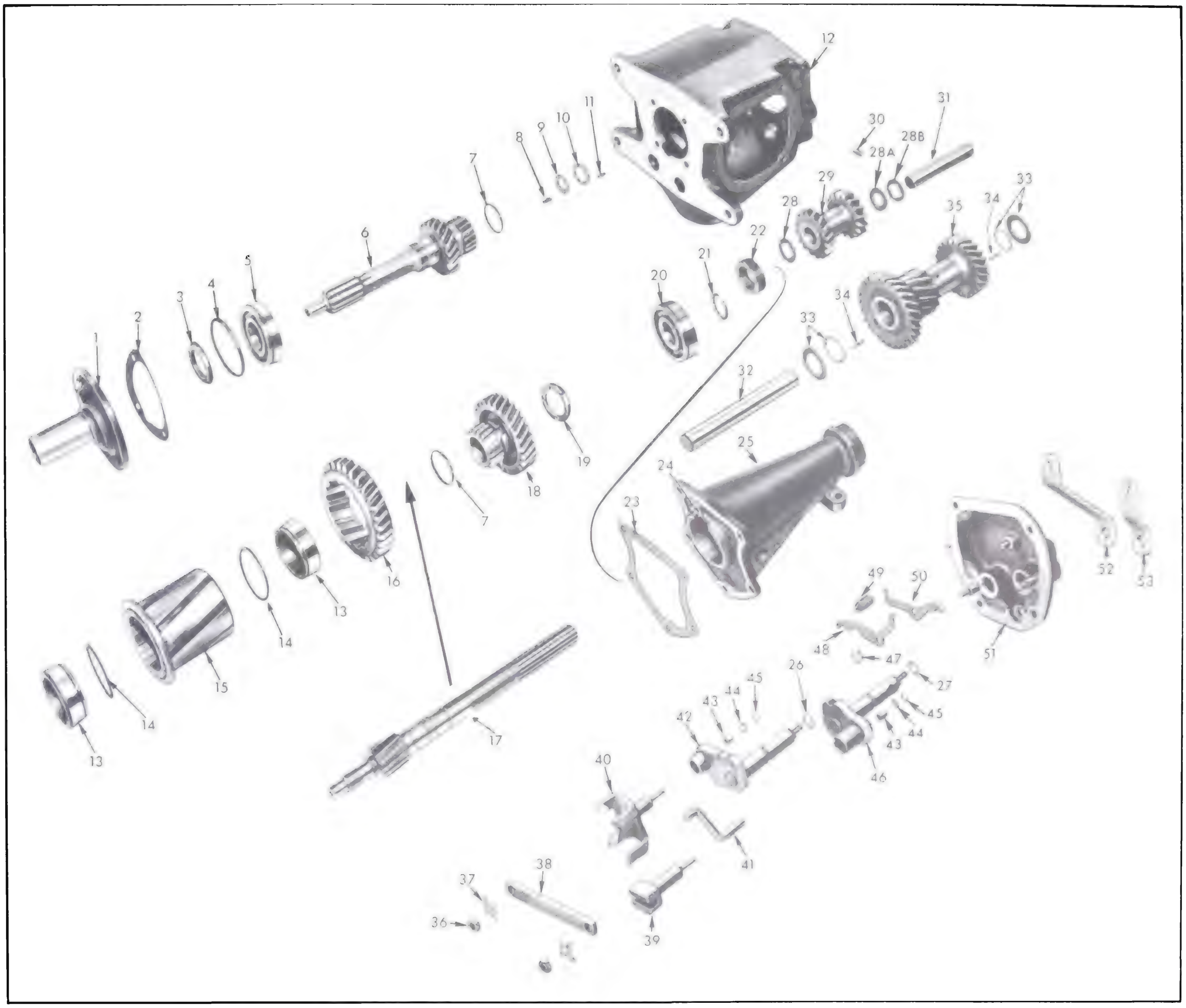


Figure 4-18—Exploded View of 3-Speed Synchromesh Transmission

1. Clutch Gear Bearing Retainer
2. Bearing Retainer Gasket
3. Bearing Nut and Oil Slinger
4. Bearing Snap Ring
5. Clutch Gear Bearing
6. Clutch Gear
7. Energizing Spring
8. Front Pilot Bearing Roller
9. Thrust Washer
10. Thrust Washer
11. Rear Pilot Bearing Rollers
12. Transmission Case
13. Synchronizer
14. Snap Ring
15. Second and Third Speed Clutch
16. First and Reverse Sliding Gear
17. Mainshaft
18. Second Speed Gear
19. Thrust Washer
20. Mainshaft Rear Bearing
21. Snap Ring
22. Speedometer Drive Gear
23. Case Extension Gasket
24. Rear Bearing Snap Ring
25. Case Extension
26. First and Reverse Shifter Lever "O" Ring
27. Second and Third Shifter Lever "O" Ring
28. Thrust Washer
28a. Thrust Bearing
28b. Thrust Bearing Washer
29. Reverse Idler Gear
30. Reverse Idler Shaft Pin
31. Reverse Idler Shaft
32. Countershaft
33. Countergear and Roller Thrust Washers
34. Bearing Roller
35. Countergear
36. Shifter Interlock Retainer Stud Nut
37. Shifter Interlock Retainer Stud Nut lock
38. Shifter Interlock Retainer
39. Second and Third Shifter Fork
40. First and Reverse Shifter Fork
41. Shifter Interlock Shaft
42. First and Reverse Shifter Lever (Inner)
43. Shifter Fork Spacer
44. Shifter Fork Washer
45. Shifter Fork Retainer
46. Second and Third Shifter Lever (Inner)
47. Detent Cam Retainer
48. First and Reverse Detent Cam
49. Detent Cam Spring
50. Second and Third Detent Cam
51. Side Cover
52. First and Reverse Shifter Lever (Outer)
53. Second and Third Shifter Lever (Outer)

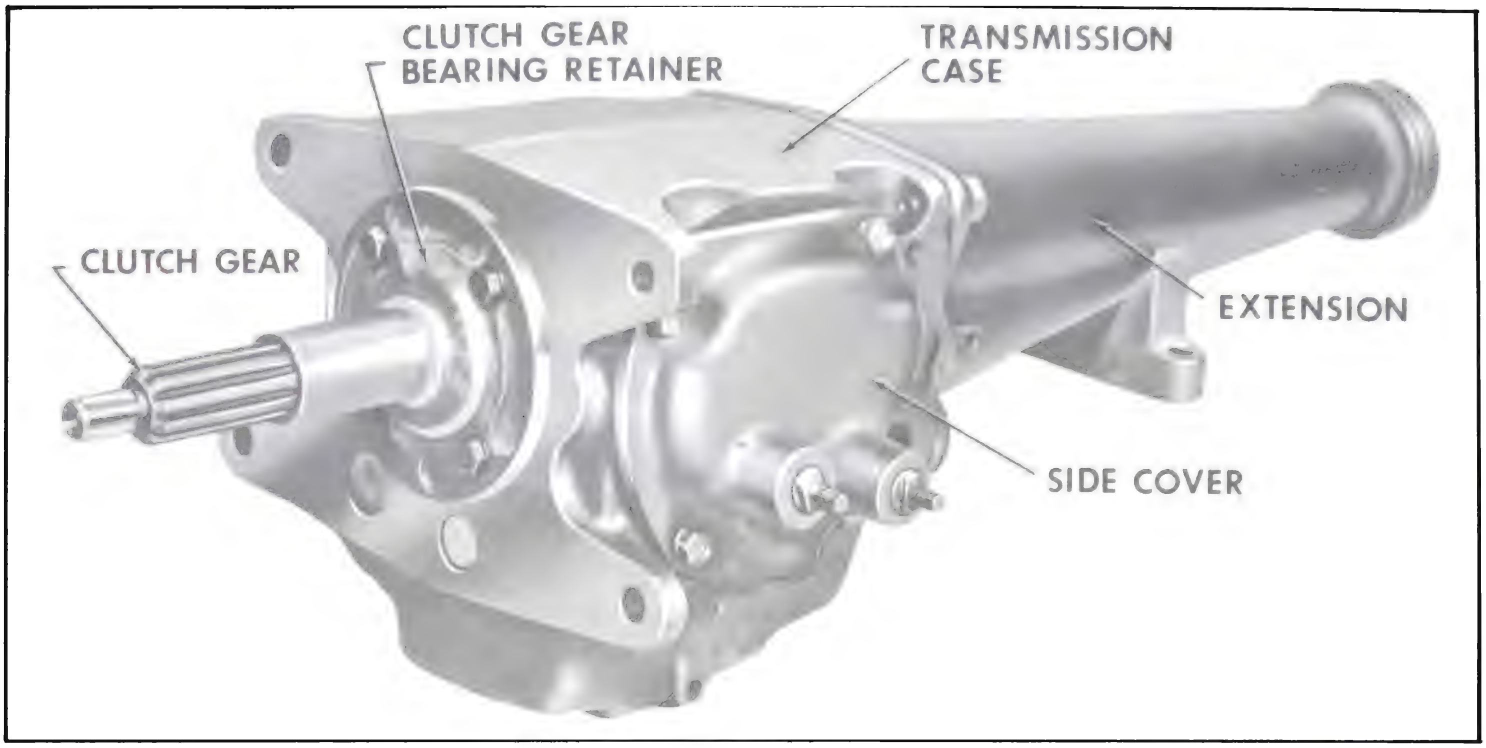


Figure 4-19—Transmission Identification

TO THE HIGH INDICATOR READING WILL CHANGE THE TRANSMISSION REAR BORE READING APPROXIMATELY .003" to .004".

10. After the position and quantity of shims has been determined and recorded, transmission case and extension may be removed.

4-19 DISASSEMBLY OF TRANSMISSION

a. Major Disassembly

1. Remove the capscrews from the transmission side cover. Remove the side cover and gasket.

2. Remove extension-to-transmission case bolts and lock washers. Pull extension and mainshaft assembly from transmission case, leaving second and third speed clutch assembly and first-reverse ring gear in the case. Do not force the mainshaft. If necessary, rotate the second - third speed clutch slightly to aid removal. See Figure 4-20.

3. Slide the first-reverse ring gear off the clutch sleeve, and remove through the side cover opening.

4. Remove the clutch assembly from the clutch gear and then remove through the side cover opening.

5. Remove the pilot bearing rollers from clutch gear.

6. Remove the four clutch gear bearing retainer screws and washers. Remove retainer and gasket.

7. Using Tool J-5777, remove the countershaft. Leaving the tool in place, lower the countergear to the bottom of the case. See Figure 4-21.

NOTE: It is necessary to lower the countergear in order to provide clearance for clutch gear removal.

8. Remove clutch gear bearing snap ring. See Figure 4-22.

9. Tap the end of the clutch gear with a soft hammer, moving the bearing and gear assembly back into the case. Remove the assembly through the rear of the case. See Figure 4-23.

10. Remove the countergear assembly through the rear of the case.

11. Using a drift pin, drive the idler shaft lock pin into the shaft.

12. Drive the idler gear shaft out of the case, being careful not to turn the shaft. See Figure 4-24.

CAUTION: Do not allow the idler shaft to rotate causing the lock pin to drop down. Damage to the washers could result.

13. Carefully remove the idler gear, thrust washer, thrust bearing, and bearing washer.

14. To remove mainshaft from extension, expand the bearing snap ring and tap the rear of the mainshaft with a soft hammer. Remove the complete mainshaft assembly from the extension. See Figure 4-25.

b. Mainshaft Repair

1. Remove speedometer drive gear with plates. See Figure 4-26.

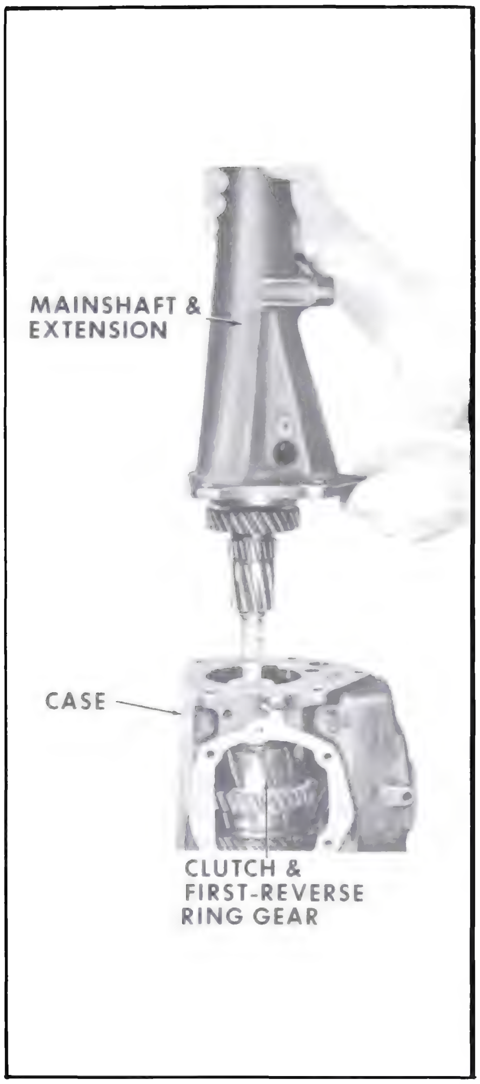


Figure 4-20—Mainshaft Removal

2. Remove bearing to mainshaft snap ring. Press bearing off shaft.

3. Remove second speed gear thrust washer and second speed gear.

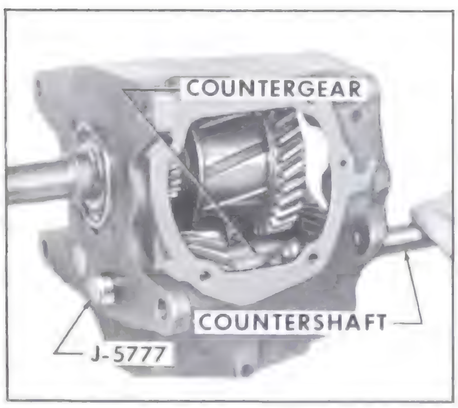


Figure 4-21—Removing Countershaft

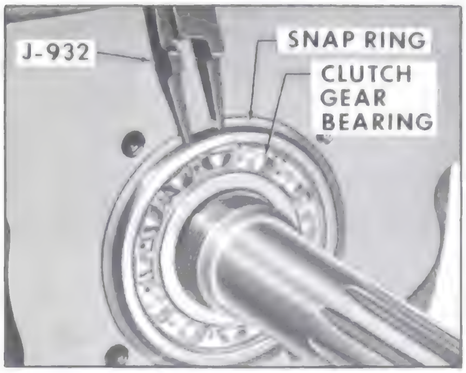


Figure 4-22—Clutch Gear Snap Ring Removal

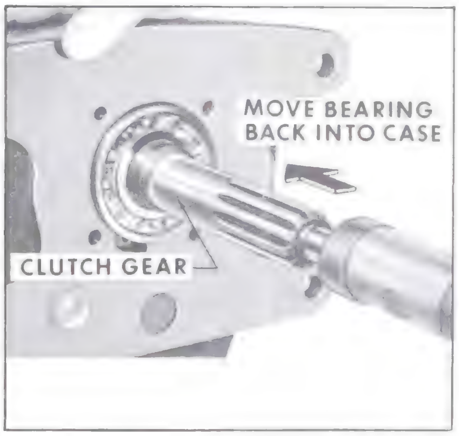


Figure 4-23—Clutch Gear Bearing Removal

4. Inspect and replace worn or damaged parts.

5. Lubricate bore of second speed gear, and install on mainshaft.

Figure 4-24—Idler Shaft Removal

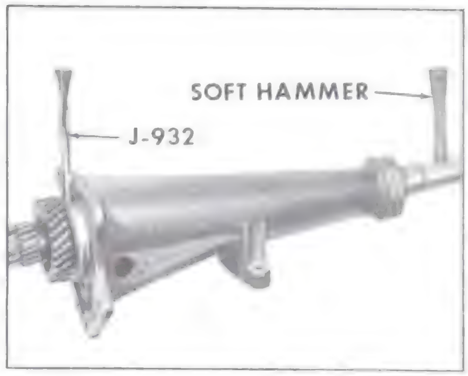


Figure 4-25—Mainshaft Removal

6. Install bearing. Make sure the groove in O.D. of bearing is toward second speed gear.

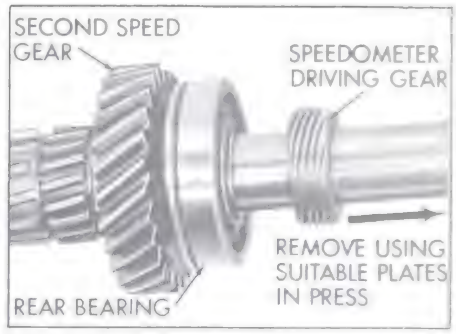


Figure 4-26—Removing Speedometer Driving Gear

7. Install correct size snap ring. Determine size by using ring that gives no more than .004" of end play between bearing and shaft.

8. Start speedometer drive gear on shaft with chamfered I.D. of gear toward bearing. Press gear on shaft until forward face of gear is 7/8" from face of bearing. See Figure 4-27.

c. Clutch Gear Bearing Repair

1. Place the clutch gear in a vise with soft jaws, and remove the bearing retainer nut and oil slinger using Tool J-0933. See Figure 4-28.

2. Install gear and bearing in transmission case. Next, install snap ring on bearing.

3. Using a soft hammer, remove the bearing from the shaft by

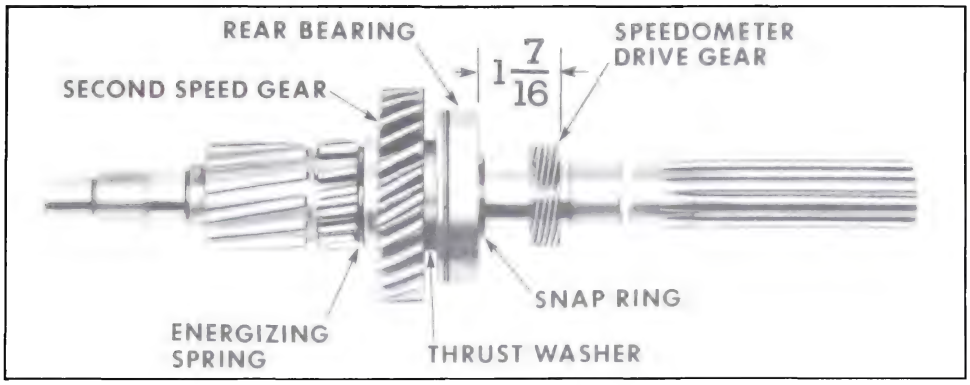


Figure 4-27—Mainshaft Identification

tapping the clutch gear shaft back into the case.

4. Remove the bearing from the case by tapping with a soft hammer.

5. After cleaning and inspecting all parts, replace any that are damaged or excessively worn.

6. Replace the bearing on the clutch gear shaft with the snap ring groove to the front.

7. Using Tool J-0933, install the bearing retainer nut and oil slinger. Tighten enough to permit free movement of the bearing. Lock in place by staking into hole with a center punch. Care must be taken not to damage the shaft threads.

d. Clutch Sleeve and Synchronizer Rings

1. Remove the first-reverse sliding gear from the clutch assembly.

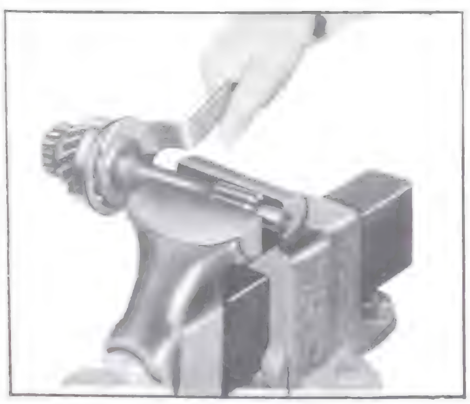


Figure 4-28—Removing Retainer Nut and Oil Slinger

2. Turn the synchronizer ring in the clutch sleeve until the ends of the synchronizer ring retainer can be seen through the slot in the clutch sleeve.

3. Using Tool J-0932, expand the retainer into the counterbore in the clutch sleeve. This raises the retainer from the groove in the ring so that the ring may be easily slipped out. See Figure 4-29.

4. Check the synchronizing rings for wear or looseness in the clutch sleeve. If rings are damaged in any way, it will be necessary to replace the clutch sleeve and both synchronizer rings.

5. Place each synchronizer retainer in its respective ring. Check for any rocking or excessive looseness. Excessive rocking will not permit proper synchronization. Replace any worn or damaged parts.

6. Install the ring retainers in the counterbores in the ends of the clutch sleeve.

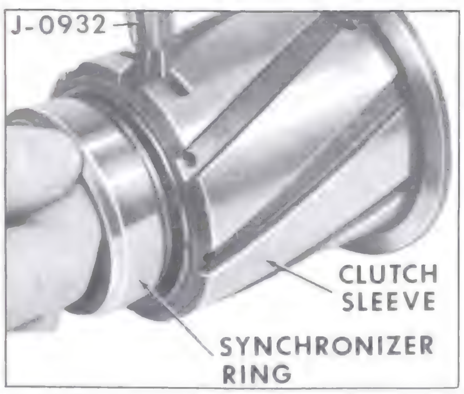


Figure 4-29—Removing Synchronizing Rings

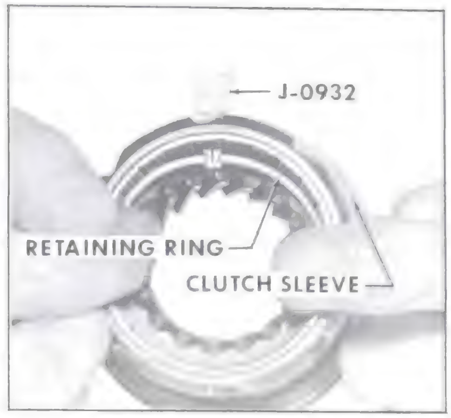


Figure 4-30—Installing Synchronizing Rings

7. Insert Tool J-0932 in the opening in the clutch sleeve. Expand the retainer with the fingers just enough to catch the tips of the tool jaws. Then open the jaws of the tool enough to expand the retainer back into the counterbore and allow the ring to slip in the sleeve. Install both rings in this manner.

CAUTION: Make sure the retainers are seated in the groove all the way around the ring, so that the ring can turn freely. See Figure 4-30.

8. Install the first-reverse sliding gear on the clutch sleeve.

e. Synchronizer Energizing Springs

1. It will be noticed upon examining these springs that one of the

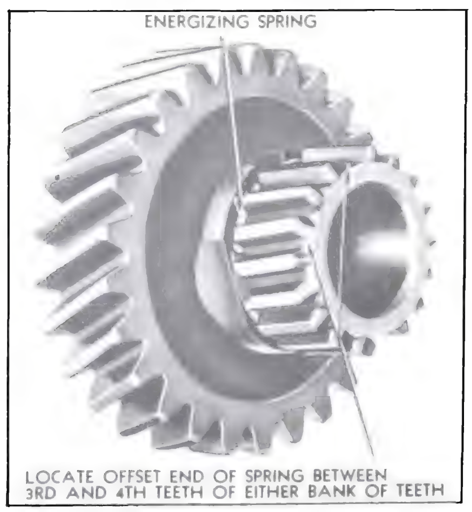


Figure 4-31—Energizing Ring Location

ends is slightly offset. Each spring must be assembled in its groove in the clutch gear and second speed gear. The offset or locking end must be between the third and fourth teeth in either bank of teeth. See Figure 4-31.

2. Under normal operation it should never be necessary to replace the energizing springs.

However, should an energizing spring be removed for any reason, a new spring should be used for replacement.

f. Side Cover Repair

1. Bend taps on the shifter shaft nut retainers downward and remove nuts, nut retainers, and shifter shaft retainer.

2. Remove detent cam spring.

3. Remove cam retaining ring and cams.

4. Using a soft hammer, remove the shifter shaft and fork assemblies.

5. Remove interlock shaft.

6. Clean all parts and inspect for damage or excessive wear. Check the "O" rings at the ends of the shifter shafts for wear. Replace any parts required.

7. Install interlock shaft.

8. Lubricate the shifter shafts with transmission oil. Align the shaft of the 1st-reverse shaft in the hole and tap in place with a soft hammer. Position interlock so as to clear shaft.

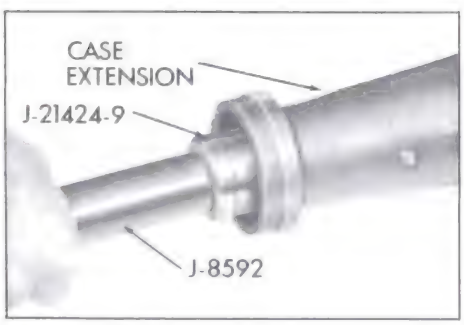


Figure 4-32—Installing Extension Bushing

9. Repeat above procedure with the 2nd-3rd shifter shaft and fork assembly.

10. Install the detent cams with the 1st-reverse cam on top of the 2nd-3rd detent cam. Retain with the special retaining ring.

11. Install detent cam spring.

12. Install shifter shaft retainer, nut retainers and nuts. Torque to 3-5 ft. lbs.

g. Extension Bushing and Oil Seal

If bushing in rear of extension requires replacement, remove oil seal with the aid of a screwdriver. Using Remover J-21424-9 and Drive Handle J-8592, drive bushing back into the extension. Using the same tools, install a new bushing in the extension from the rear. Drive it in until the end of the bushing is slightly below counterbore for oil seal. Coat I.D. of bushing with transmission lubricant and install new oil seal using Tool J-8613.

4-20 TRANSMISSION ASSEMBLY

1. Coat reverse idler thrust-washers and the thrust bearing with grease and install as shown in Figure 4-33. Coat bushings with transmission lubricant.

2. Place gear assembly in position in case with thrust bearing toward rear.

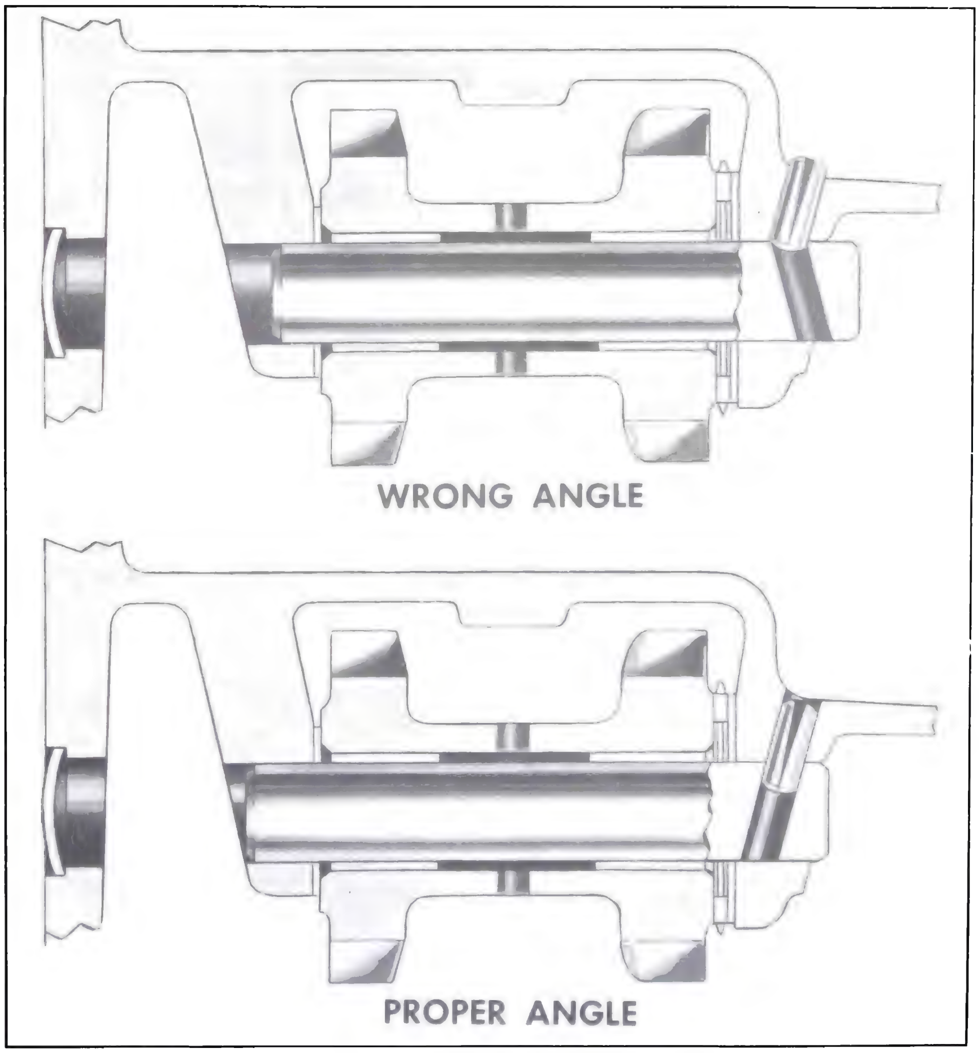


Figure 4-33—Reverse Idler Gear

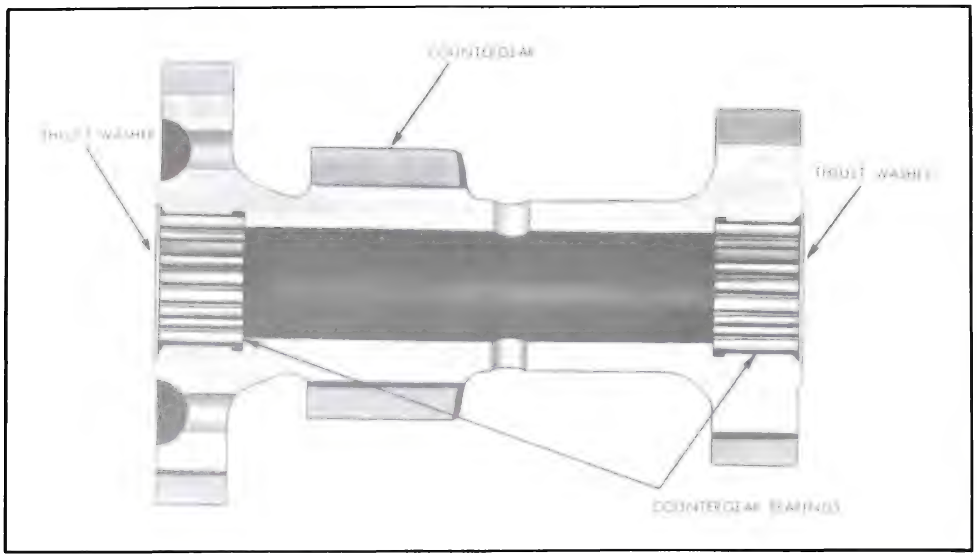


Figure 4-34—Countergear and Bearings

3. Install the idler shaft, making sure the lock pin hole in the shaft lines up with the hole in the case at the same angle. See Figure 4-26.

4. Coat a new idler shaft lock pin with Permatex No. 2 or its equivalent. Drive it in approximately 1/16" beyond flush with the case. Peen the hole slightly.

5. Install idler shaft expansion plug in case.

6. Place some cup grease in the roller bearing area on each end of countergear. Insert Tool J-5777 in countergear. Install 25 roller bearings in each end. Apply grease to bearing thrust washers; place one of each at each end of countergear. See Figure 4-34.

7. Insert countergear (with Tool J-5777) in transmission case and rest it on bottom of case.

8. Place some cup grease in the mainshaft pilot hole in the clutch gear and install the roller bearings. Install the larger group of 14 bearings and then the washer with the small I.D. Next install the washer with the large I.D. and then the group of 24 smaller roller bearings.

9. Insert clutch gear from inside case and using a soft drift, tap the outer race of the clutch gear bearing (back of gear) until the bearing locating ring groove is outside the front of the case. Drive the assembly straight to prevent damage. See Figure 4-35.

10. Install snap ring on bearing and tap clutch gear rearward until snap ring is firmly against case.

11. Install the clutch gear bearing retainer and gasket. Make sure the oil slot in the retainer lines up with the oil slot in the front fice of the case. Do not allow the gasket to protrude beyond the edge of the retainer. See Figure 4-36.

12. Coat the retainer screws with Permatex No. 2 or equivalent and install in retainer, using the special shakeproof washers. Tighten to 12-15 ft. lbs. torque.

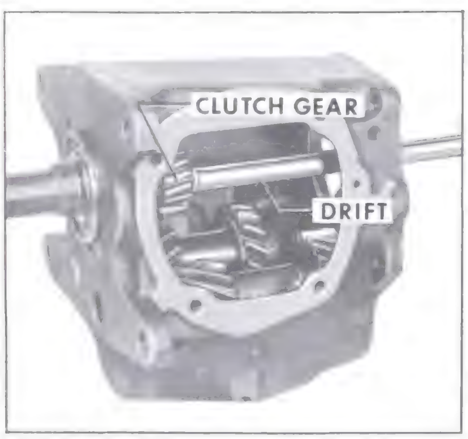


Figure 4-35—Clutch Gear Installation

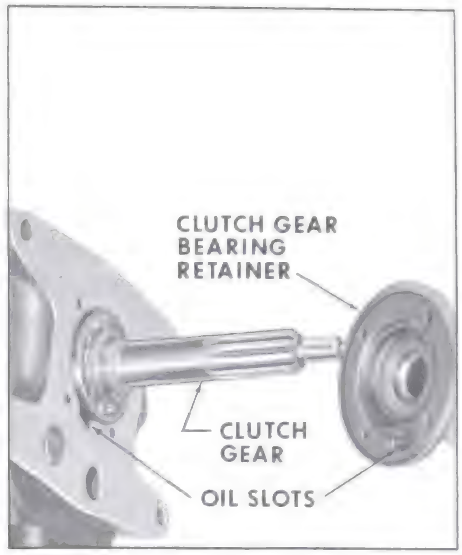


Figure 4-36—Clutch Gear Bearing Retainer Oil Slot

13. Lubricate and insert countershaft in rear of case. Align countergear with shaft and tap shaft thru, pushing Tool J-5777 out front of case. Be sure the flat on the end of countershaft is horizontal and to the bottom of the case. See Figure 4-37.

14. After shaft is aligned as described above and as shown in Figure 4-37, drive shaft into case until the flat on shaft is flush with case.

CAUTION: Flat on shaft must be horizontal and at bottom of case in order to allow the rear extension to fit properly.

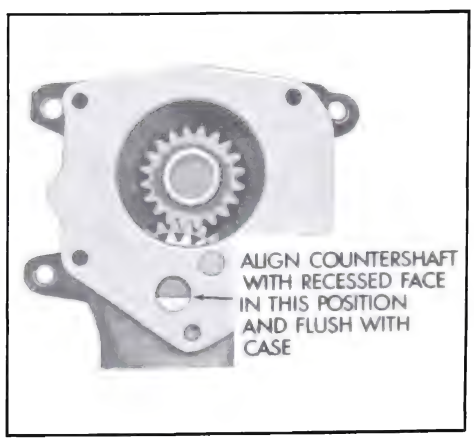


Figure 4-37—Countershaft Alignment

15. Assemble the first - reverse ring gear on the clutch sleeve.

Insert this assembly into the side cover opening by tipping the front end of the unit into the opening first. Align the lug of the synchronizing ring with the slot in the clutch sleeve when positioning the assembly on the clutch gear. See Figure 4-38.

16. Install mainshaft in extension and secure with snap ring.

17. Install gasket on transmission case rear face.

18. Align lugs on synchronizer rings with slot in mainshaft so that the lugs slide in slots on gear. Be sure that the clutch gear roller bearings are still in position. Push the shaft into the clutch sleeve until the extension is tight against the case. See Figure 4-39. Install bolts and lock washers. Torque to

NOTE: Coat the lower extension bolt with Permatex No. 2 or equivalent before installation. Torque to 40-45 ft. lbs.

19. Place transmission gears in neutral and shift forks on side cover in neutral. Install cover to transmission using a new gasket. Coat screws with Permatex No. 2 or equivalent. Torque to 15-18 ft. lbs.

20. Attach control levers to studs on shifter forks. Torque to

21. Fill transmission with 2 pints of SAE 90 transmission lubricant.

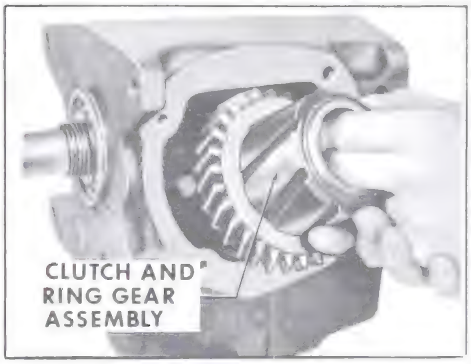


Figure 4-38—Installing Clutch and Ring Gear

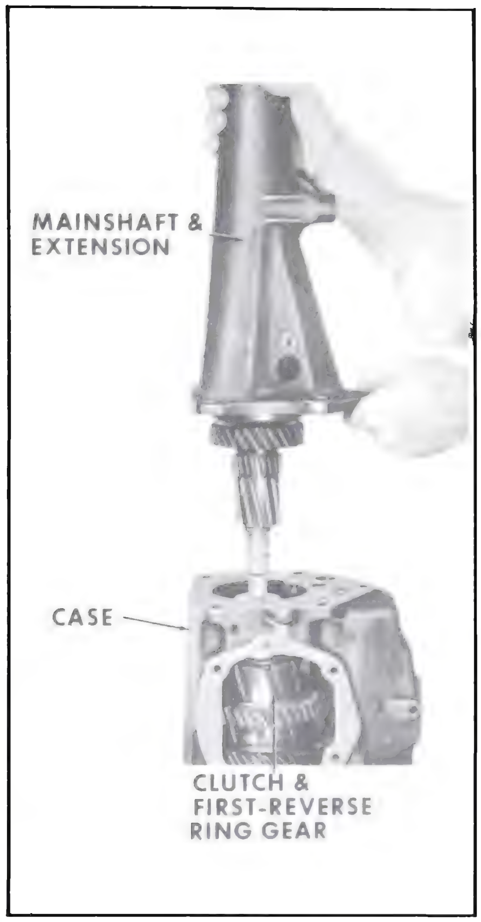


Figure 4-39—Mainshaft and Extension Installation

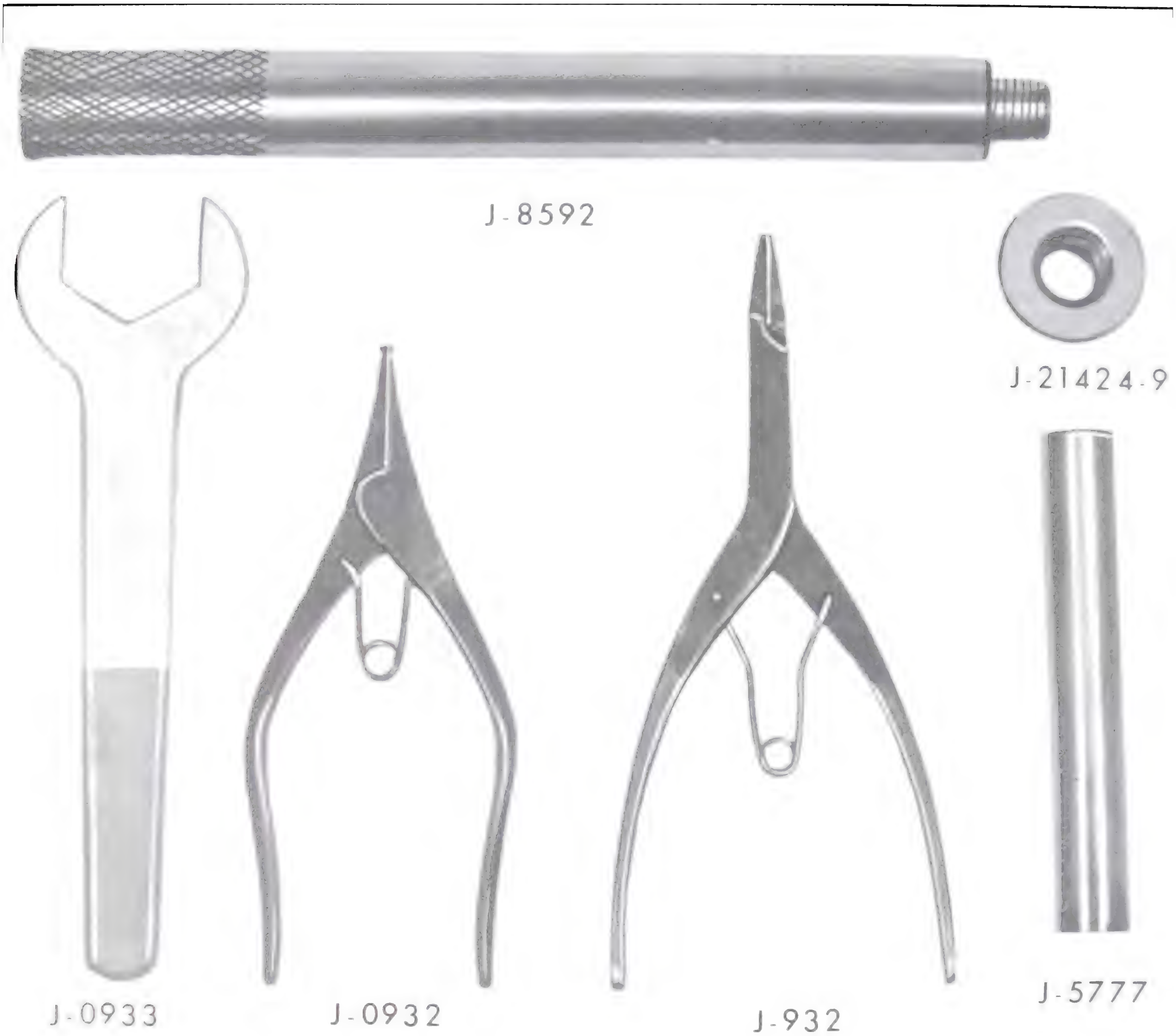


Figure 4-40—3-Speed - Synchromesh
Tools

SECTION 4-D

3-SPEED SYNCHROMESH—4600

CONTENTS OF SECTION 4-D

4-21 TRANSMISSION SPECIFICATIONS

a. Tightening Specifications

Part	Location	Thread Size	Torque
Bolt	Extension Adapter to Case	Special	20-30
Bolt	Extension to Case (3 Upper Location)	1/2-13 x 1 5/8	35-45
Bolt	Extension to Case (2 Lower Location)	7/16-14 x 1 1/8	20-30
Bolt	Upper Flywheel Housing to Cylinder Block	7/16-14 x 1 3/4	45-60
Bolt	Lower Flywheel Housing to Cylinder Block	5/16-18 x 1/2	15-20
Screw	Lower Flywheel Housing to Upper Flywheel Housing	1/4-20 x 5/8	15-20
Nut	Shifter Lever to Shifter Shaft	5/16-18	10-15
Bolt	Control Housing to Case	5/16-18 x 7/8	15-20
Bolt	Main Drive Gear Bearing Retainer To Case	5/16-18 x 3/4	15-20

b. Transmission Specifications

Mounting	Unit with Engine
Oil Capacity	3 1/2 Pints
Type of Gearing	All Helical
Transmission Ratios	
In First	2.490 to 1
In Second	1.587 to 1
In Third	1 to 1
In Reverse	3.154 to 1

c. Speedometer Gears

Speedometer Worm on Main Shaft	Press Fit
Teeth on Worm (3.36 Ratio)	8
Teeth on Driven Gear	19
Teeth on Worm (3.23 Ratio)	9
Teeth on Driven Gear (3.23 Ratio with 7.60 x 15)	21
Teeth on Driven Gear (3.23 Ratio with 8.00 x 15)	20

4-22 S-M TRANSMISSION DESCRIPTION

The synchromesh transmission is solidly bolted to the rear face of the flywheel upper housing, to form a unit assembly with the engine. The transmission drive gear shaft extends the clutch driven plate into a bronze bushing seated in the rear end of the engine crankshaft. The front bearing retainer projects into a bore in the flywheel housing, serving as a pilot to center the transmission with the engine crankshaft.

a. Transmission Gears and Shafts

The transmission main drive gear is supported by a ball bearing which is a slip fit in the front wall of the transmission case. The ball bearing is shielded on the rear side by a slinger washer.

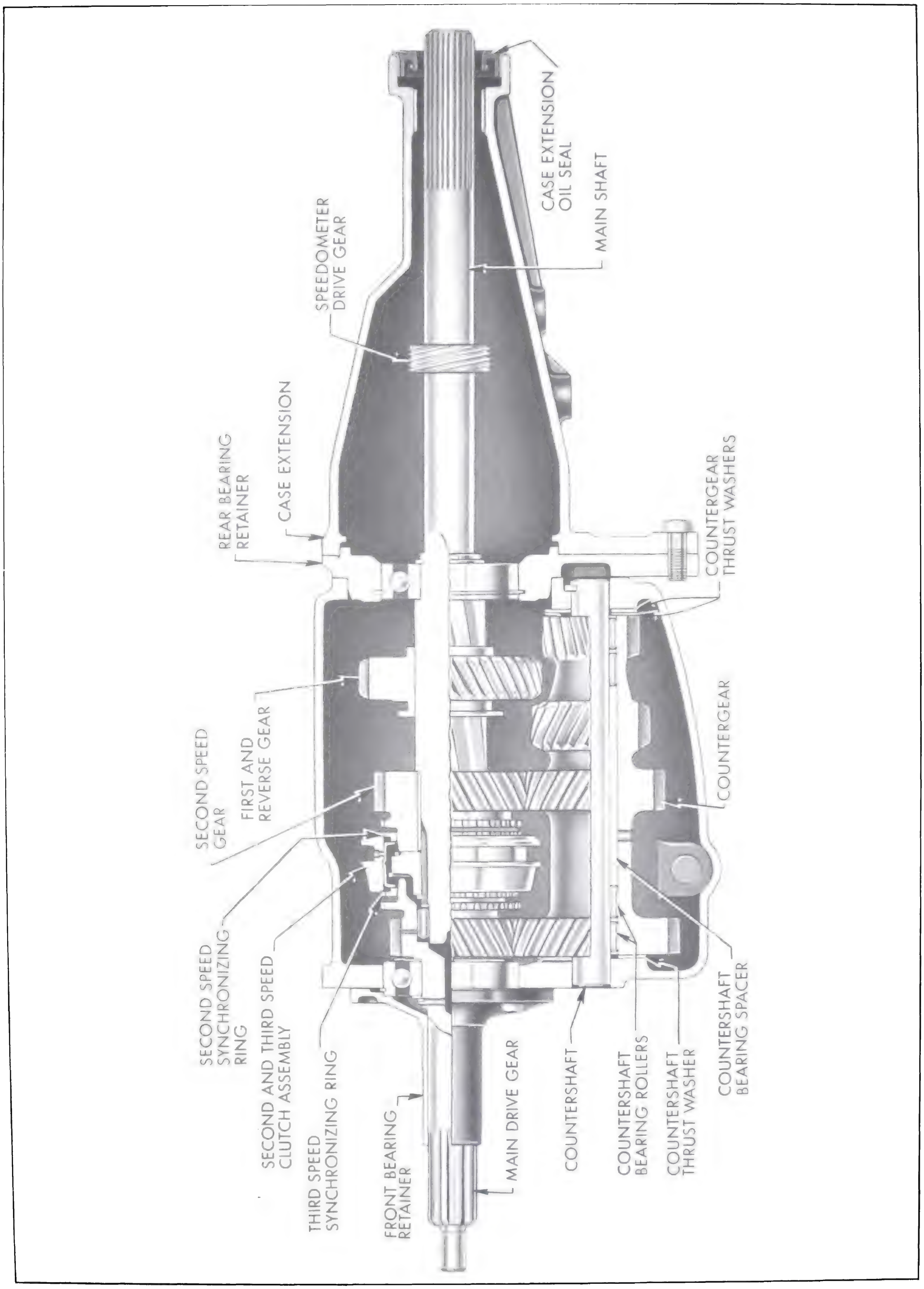


Figure 4-77—Cross Section of 4600 3-Speed Synchromesh Transmission

This washer is held tight against a shoulder on the drive gear by the bearing pressed against it. The bearing is prevented from moving away from the washer by a selective fit snap ring in a groove in the drive gear shaft. The outer race of the bearing is grooved for a snap ring which fits between the transmission case and the front bearing retainer to hold the bearing and main drive gear in place. See Figure 4-10.

The front end of the transmission main shaft is piloted in the bored rear end of the main drive gear by 14 loose rollers. The rear end of the main shaft is supported by the transmission rear bearing which is a slip fit in the rear wall of transmission case. The outer race of the rear bearing is grooved for a snap ring which fits between the transmission case and the rear bearing retainer. The inner race of the bearing is retained between a shoulder on the main shaft and a snap ring in a groove in the shaft.

The transmission countergear is supported by a set of 22 needle rollers on each end of the countershaft. The countershaft is held in position by its tight fit in the forward hole and by a lock plate between it and the reverse idler gear shaft. A tubular spacer separates the two sets of rollers and two washer-type spacers are located at the outer ends of each set to hold the rollers in position. End thrust is taken by a single thrust washer in the front and two thrust washers in the rear. A hole in the hub of the countergear permits lubricant to reach the bearings and thrust washers.

The reverse idler gear is provided with a bronze bushing and is supported on a shaft which is held stationary a a lock plate between it and the countershaft. End clearance of the gear permits lubricant to reach the bushing. The second speed gear is provided with a bronze bushing and is mounted on the mainshaft in such a position that it is constant mesh with the countergear. It is held in position between the front shoulder of the first-reverse gear splines and the hub of the synchronizer assembly. The gear is free to rotate on the mainshaft except when engaged by the synchronizing assembly during second speed operation. See Figure 4-77.

The first-reverse sliding gear is splined to the mainshaft to the rear of the second speed gear so that it can be moved forward to engage the countergear for first speed or rearward to engage the reverse idler for reverse.

b. Gear Shift and Synchronization

The synchronizing assembly and the first-reverse gear are actuated by the shift mechanism. The gear shift mechanism is described in Group 4A. The synchronizing assembly is splined to the mainshaft to transmit drive when the assembly is engaged with either the drive gear (third speed) or the second speed gear. The synchronizing assembly includes a hub, sleeve, shift plates, springs and blocking rings which act to synchronize the speed of the gear to be engaged with the speed of the hub during a shift into either second or third speed. As the sleeve moves toward the gear to be engaged, the shift plates press the blocking ring into contact with the gear, after which the springs allow the shift plates to slide out of the detent notches in the sleeve to permit the sleeve to engage the gear quietly and easily.

c. Speedometer Gears

The speedometer driving worm gear is held against a shoulder on the transmission mainshaft by forward pressure of the front companion flange. When changing rear axle ratios it is necessary to change the driven gear, and on some axle ratios it is necessary to change the driven worm gear. The speedometer driven gear assembly consists of a sleeve, a gear and shaft, an "O" ring sleeve seal, a sleeve retainer and bolt. The driven gear sleeve is a slip fit in the rear bearing retainer. The sleeve is held in place by a retainer which fits into a slot in the sleeve and is bolted to the rear bearing retainer. The gears are lubricated by splash from the transmission. The speedometer cable is attached to the sleeve by a threaded sleeve on the cable casing.

d. Front Companion Flange

The front companion flange is splined to the rear end of the transmission mainshaft and is retained by a heavy steel washer and bolt. The length of the front companion flange is such that it bottoms against the speedometer drive gear. An oil seal is located in the rear end of the rear bearing retainer with the seal lip contacting the companion flange.

e. Power Flow Through Transmission

1. In first speed, the first speed sliding gear is slid forward on the mainshaft splines so that it engages its corresponding gear on the countergear. See Figure 4-78 to follow the power flow.

2. In second speed, the clutch sleeve is slid rearward on the synchronizer hub so that it first synchronizes the speed of the second gear, then engages the projecting teeth on the second gear. See Figure 4-78.

3. In third speed, the clutch sleeve is slid forward on the synchronizer hub so that it first synchronizes the speed of the drive gear, then engages the projecting teeth on the drive gear. See Figure 4-78.

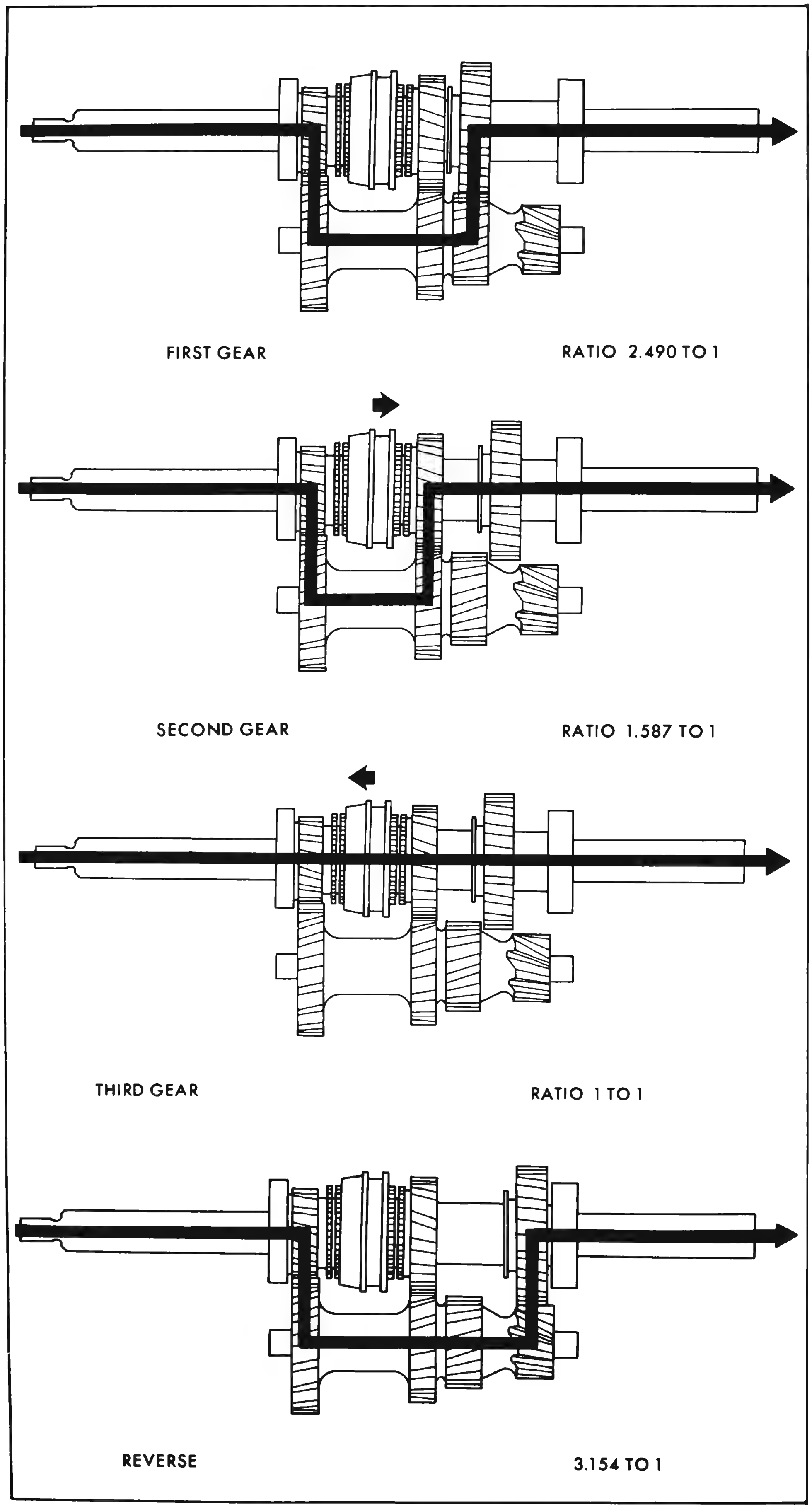


Figure 4-78—Transmission Power Flow

4. In reverse, the first-reverse gear is slid rearward on the mainshaft splines so that it engages the reverse idler, which is in constant mesh with a corresponding gear on the countergear. The idler gear reverses the direction of rotation of the complete drive train in the rear of the reverse idler.

f. S-M Transmission Shift Control Mechanism

Both shift levers are located on the left side of the transmission. The forward lever controls the second-third shift; the rear lever controls the first-reverse shift.

When the second-third shift lever is moved forward by the equalizer lever, a shift shaft with an integral notched cam is rotated to cause a shift fork to move rearward. This moves the clutch sleeve rearward to first synchronize the speed of the second gear and then to engage the projecting teeth on the second gear. When the second-third lever is moved rearward, the notched cam is rotated in the other direction and the clutch sleeve is moved forward to first synchronize the speed of the drive gear and then to engage the projecting teeth on the drive gear.

When the first-reverse lever is moved rearward, a shift shaft with an integral notched cam is rotated to cause a shift shoe to move forward. This moves the first-reverse gear forward to engage its corresponding part on the countergear. When the first-reverse lever is moved forward, the notched cam is rotated in the other direction and the first-reverse gear is moved rearward to engage the reverse idler gear.

When either shift lever is moved from the center or neutral position, an interlock mechanism located between the second-third shift cam and the first-reverse shift cam prevents the other shift

lever from being moved from its neutral position. This prevents the possibility of shifting into two gears at once, which would lock-up the transmission.

The interlock mechanism consists of an interlock sleeve, pin, spring and two balls. Each shift shaft cam has three grooves into which the interlock springs pushes the balls; these detents make a definite position for each shift. Each cam is lower in the center or neutral position and higher each side of the neutral position. When either cam is shifted out of the neutral position, the interlock sleeve is slid over so that is almost touches the other cam which is in the neutral position. The interlock sleeve therefore prevents this other cam from being shifted out of its neutral position unless the first cam is returned to neutral.

4-23 S-M TRANSMISSION TROUBLE DIAGNOSIS

a. Hard Shifting and Block-out

Hard shifting may be caused either by conditions in the shift control mechanism or by conditions in the transmission assembly. Disconnect the shift rods at the control shaft levers to determine which is at fault.

b. Low and Reverse Gear Clash

Transmission gears can be made to clash by shifting into first or reverse gear too quickly after the clutch pedal is depressed, even though clutch is in perfect working order. This is because inertia of the clutch driven plate, drive gear and countergear causes these parts to spin until stopped by friction of the transmission and transmission lubricant. With warm transmission lubricant and low friction transmission bearings, a reasonable amount of spin is to be expected. The clash does not occur when shifting quickly into second or high gear with the car standing still because the synchronizing unit stops the spinning parts.

To eliminate gear clash, sufficient time MUST be allowed before shifting into first after the pedal is depressed or else starts must be made in second gear. There is no objection to making starts in second gear on level ground since the clutch slippage under ordinary driving conditions is not sufficient to produce enough heat to damage the driven plate facings.

If gear clash continues after allowing proper time for the clutch driven plate parts to stop, check the clutch pedal lash and adjust to specified limits. See Section 4-B. Make sure that the idle speed is properly set. A faster idle aggravates driven plate spinning.

Conditions within the transmission which may cause gear clash are: (1) Faulty blocking rings or cone surfaces; (2) Excessive mainshaft end play; (3) Weak or broken detent springs in the synchronizing hub. Gear clash also may be caused by a dragging clutch plate.

c. Noise in Neutral

With the car standing, engine running, the transmission in neutral, the transmission parts in operation are; main drive gear and bearing, countergear and bearings, reverse idler gear, second speed gear. Disengaging the clutch will stop movement of all these parts. By disengaging and engaging the clutch it can be determined whether the noise originates in these transmission parts and whether the noise is normal. Noise in neutral in the form of a constant regular click is usually caused by a nicked gear or bearing.

d. Gear Noise

Some gear noise is to be expected in all except third speed. Comparison with another car is the only means of determining whether or not gear noise is excessive. Before removing the transmission for correction of gear noise, determine by test which gears are noisy under load, so that these parts can be thoroughly inspected when removed.

e. Gear Rattle During Acceleration

An improperly calibrated clutch driven plate, a faulty crankshaft balancer, or scored rear axle gears may cause rattle in the transmission in third speed on acceleration. Rattles occurring on wide open throttle between 40 and 60 MPH are usually caused by improper clutch driven plate dampening; a new driven plate should be installed if rattles are objectionable.

f. Noise When Shifting out of First or Reverse

Shifting out of first or reverse very slowly will usually result in some noise just as the gears disengage. This is normal because of the gear pointing necessary for easy engagement.

Abnormal noise during a normally fast shift may be caused by improper clutch release. Check clutch pedal lash and adjust. See Section 4-B.

Abnormal noise during a normally fast shift, when clutch release is satisfactory, may be caused by damage to the pointing on the engaging side of the teeth on the countergear, reverse idler gear.

or first-reverse sliding gear. Noise when disengaging both first and reverse indicates that the fault is with the sliding gear only. Noise when disengaging reverse only indicates that the reverse idler gear is at fault. Noise when disengaging first speed only indicates that the countergear is at fault. Tests must be made by disengaging gears while car is still in motion.

g. Gear Jump-Out

In any case of gear jump-out, first check the adjustment of the gear shift control mechanism as described in Group 4-A. Make certain that interlock balls have full engagement in the notches in the shift shaft cam through all speed positions including neutral.

Gear jump-out in third speed may be caused by misalignment between the flywheel housing hole and the crankshaft. Check bore and face run out. It must not exceed .005.

Gear jump-out in any transmission speed position may be caused by loose fit of the bearings or bushings involved, a weak interlock spring, loose fit of the synchronizing hub on the mainshaft, loose fit of the first-reverse gear on the mainshaft, worn teeth on mating gears. All items should be carefully inspected.

h. Scored or Broken Gear Teeth

Gear teeth will be seriously damaged and possibly broken by failure of the car operator to fully engage the gears on every shift before engaging the clutch and applying engine power.

Considerable damage to gears and bearings may result from running at abnormal speeds in reverse, first and second speed gears. This practice is also detrimental to the engine.

4-24 REMOVAL AND INSTALLATION OF SYNCHROMESH TRANSMISSION

a. Removal of Transmission

1. If transmission is to be disassembled, drain transmission lubricant. Fill with kerosene and run transmission in neutral about 15 seconds. Drain kerosene.

2. Mark front companion flange and propeller shaft so that these parts can be reassembled in the same relative position. Remove U-bolts attaching front companion flange to propeller shaft. Slide front propeller shaft rearward as far as possible for working clearance.

3. Disconnect shift linkage from transmission by first removing equalizer spring. Slide shift equalizer to full left position to disengage it from 2nd-3rd shift lever, then slide equalizer to right to remove from support pin. Remove transmission 1st-reverse shift lever from shift shaft. By disconnecting shift linkage in this way, shift linkage is not disturbed and should not require readjusting.

4. Disconnect speedometer cable from transmission.

5. Loosen all three exhaust pipe joints so that transmission and rear end of engine can be lowered.

6. Disconnect clutch push rod.

7. Remove two bolts attaching transmission mounting pad to transmission support. Leave mounting pad bolted to transmission.

8. Place a flat wood block on jack. Jack under engine pan until transmission mounting pad just clears transmission support.

9. Remove four bolts attaching transmission support to body members. Remove support, then lower jack so that transmission will clear underbody during removal.

10. Remove upper left transmission to flywheel housing bolt and install J-1126 guide pin; remove lower right bolt and install J-1126.

11. Remove the other two transmission to flywheel housing bolts. Slide transmission straight back until drive gear shaft is clear of flywheel housing. CAUTION: <u>If weight of transmission is allowed to rest on main drive gear while drive gear splines are in clutch driven plate, driven plate may be damaged.</u>

b. Installation of Transmission

1. Lightly coat splines on end of main drive gear with Lubriplate for a distance of about 1 inch. Do not apply an excess that will push off at driven plate hub and get on clutch facings. Fill groove in inner surface of throw-out bearing with wheel bearing grease.

2. Make certain that front face of transmission case and rear face of flywheel housing are absolutely clean. Install J-1126 guide pin in upper left flywheel housing hole; install guide pin in lower right hole.

3. Shift transmission into 3rd gear. Lift transmission into place on guide pins and slide straight forward, meanwhile fully supporting transmission. Rotate companion flange as required to engage drive gear with driven plate splines. CAUTION: <u>If weight of transmission is allowed to rest on main drive gear shaft before shaft engages pilot bushing in flywheel, driven plate may be damaged.</u>

4. Install two transmission to flywheel housing bolts; remove guide pins and install other two bolts. Tighten all four bolts securely.

5. Raise jack under engine pan so that transmission mounting pad will clear transmission support.

6. Install transmission support, leaving four nuts loose. Lower jack so that transmission rests on support.

7. Install two bolts attaching mounting pad to support, then tighten all six bolts securely.

8. Align exhaust system, if necessary, and tighten three joints.

9. Connect speedometer cable to transmission.

10. Install 1st-reverse shift lever on transmission shaft and tighten nut securely. Install shift equalizer by first sliding left end of equalizer over support pin, then engaging right end of equalizer with 2nd-3rd shift lever. Install equalizer spring.

11. Align mark on propeller shaft with mark on front companion flange. Install U-bolts and lock plates. If there is any doubt as to safety of lock plates, use new lock plates. Tighten nuts securely and bend up lock plate tabs. Make sure propeller shaft center bearing insulator is in position in support bracket.

12. Fill transmission with specified gear lubricant.

13. Connect clutch push rod.

14. Check adjustment of shift linkage. See Group 4-A. Check adjustment of clutch linkage.

15. Road test car, checking for proper shifting, correct synchronization, and quiet operation.

c. Transmission Side Cover Removal and Installation

NOTE: It is not necessary to remove transmission from vehicle for inspection or replacement of parts in transmission side cover assembly, but the side cover assembly itself must be removed from the transmission case.

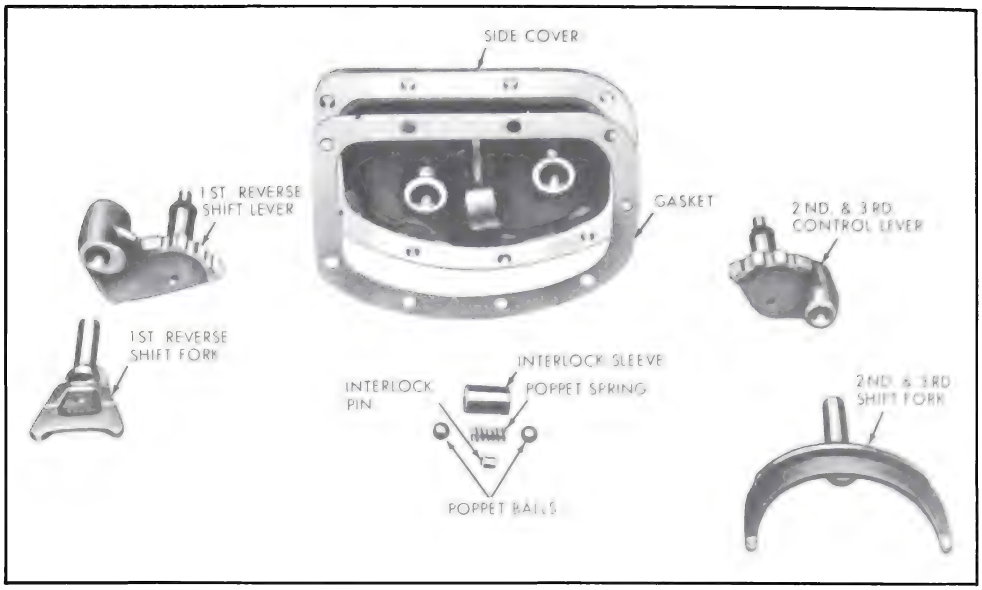


Figure 4-79—Transmission Side Cover

a. Removal

1. Remove drain plug at the bottom of transmission and drain lubricant.

2. Remove first-reverse, and second-third shift rods from levers.

3. Remove transmission side cover assembly from transmission case.

4. Remove the outer shifter lever nuts and lock washers and pull levers from shafts.

5. Carefully push the shifter shafts into cover, allowing the detent balls to fall free, then remove both shifter shafts. See Figure 4-79.

6. Remove interlock sleeve, interlock pin and poppet spring. See Figure 4-79.

7. Replace necessary parts.

b. Installation

1. Install interlock sleeve and one shifter shaft. Place steel detent into sleeve followed by poppet spring and interlock pin.

2. Start second shifter shaft into position and place second detent ball on poppet spring. Compress ball and spring with screwdriver and push the shifter shaft fully in. See Figure 4-79.

3. With transmission in neutral and shifter forks and levers in place, lower side cover into place. Install attaching bolts, using sealer in lower right bolt and tighten evenly.

4-25 DISASSEMBLY AND ASSEMBLY OF 3-SPEED SYNCHROMESH

a. Disassembly of 3-Speed Synchromesh Transmission

1. Remove transmission side cover assembly from transmission case. NOTE: If cover assembly is to be disassembled for inspection or replacement of worn parts, follow procedures 2 through 6, Section 4-31, paragraph c.

2. Remove front companion flange. Assemble Puller J-8614 as shown in Figure 4-80 and pull companion flange from mainshaft.

3. Remove case extension oil seal. See Figure 4-81.

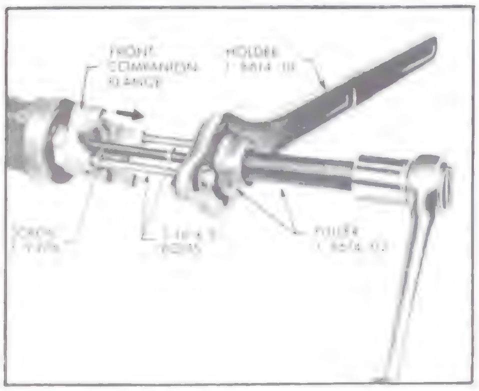


Figure 4-80—Removing Front Companion Flange

4. Remove five bolts attaching the case extension to the rear bearing retainer. Tap extension with a soft hammer in a rearward direction to start.

5. Remove speedometer gear with J-8760 as shown in Figure 4-82.

6. Remove rear bearing retainer to transmission case bolt. See Figure 4-83.

7. Move rear bearing retainer away from case approximately one-half inch, then remove welch plug in retainer using brass drift.

8. Rotate bearing retainer to expose countershaft and lock key. See Figure 4-84.

9. From front of transmission case, drive countershaft to rear, using countershaft bearing loader J-9573.

10. Drive countershaft all the way out and leave Tool J-9573 in the countergear to retain the needle roller bearings.

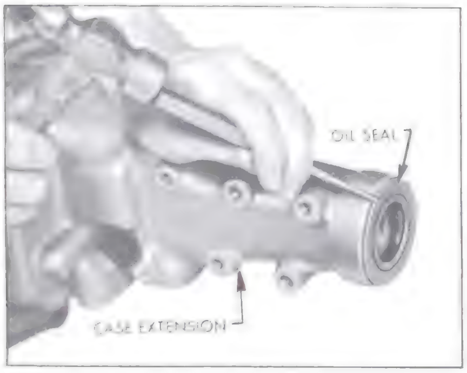


Figure 4-81—Extension Oil-Seal Removal

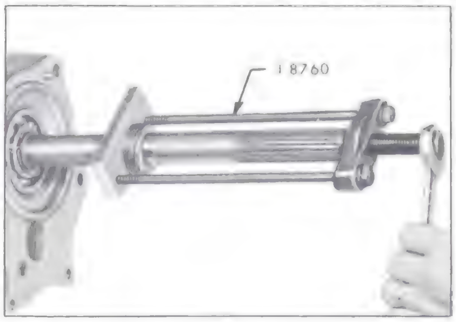


Figure 4-82—Removing Speedometer Gear

11. Drop countergear down in transmission case.

12. Carefully remove the entire mainshaft assembly.

13. Remove bearing spacing washer and 14 needle roller bearings from inside the main drive gear.

14. Remove four bolts from front bearing retainer and remove retainer and gasket. See Figure 4-85.

15. Remove main drive gear snap ring and washer from main drive gear, using Snap Ring Pliers J-5586. See Figure 4-85.

16. With a soft hammer, tap main drive gear down from front bearing as shown in Figure 4-86.

17. From inside case, tap out front bearing and snap ring. See Figure 4-87.

18. Using a small brass drift, drive reverse idler gear shaft to rear of case until lock key can be removed.

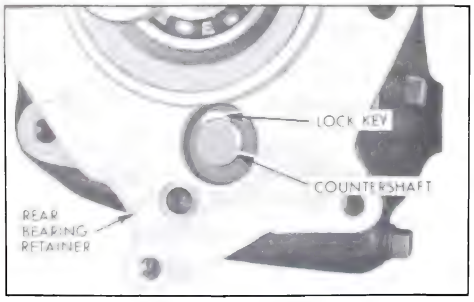


Figure 4-83—Removing Retainer to Case Bolt

Figure 4-84—Rear Bearing Retainer Location

19. Remove lock key and, from rear of case, drive idler gear shaft into case.

20. Remove reverse idler gear and shaft from transmission case.

21. Remove countergear assembly and thrust washers from transmission case.

22. Remove Tool J-9753 from countergear and remove the 80 needle roller bearings, four bearing retaining washers and bearing spacer from inside the countergear.

23. Remove synchronizing ring from front side of 2nd and 3rd speed clutch sleeve. See Figure 4-88.

24. Remove clutch hub retaining snap ring from front end of mainshaft, using snap ring pliers as shown in Figure 4-88.

25. Remove 2nd and 3rd speed clutch sleeve and hub from mainshaft. See Figure 4-88.

26. Remove rear synchronizing ring and second speed gear from mainshaft. See Figure 4-88.

27. Remove 1st-reverse sliding gear from mainshaft. See Figure 4-88.

28. Spread rear bearing retainer snap ring and with a soft hammer, tap mainshaft out of retainer. See Figure 4-89.

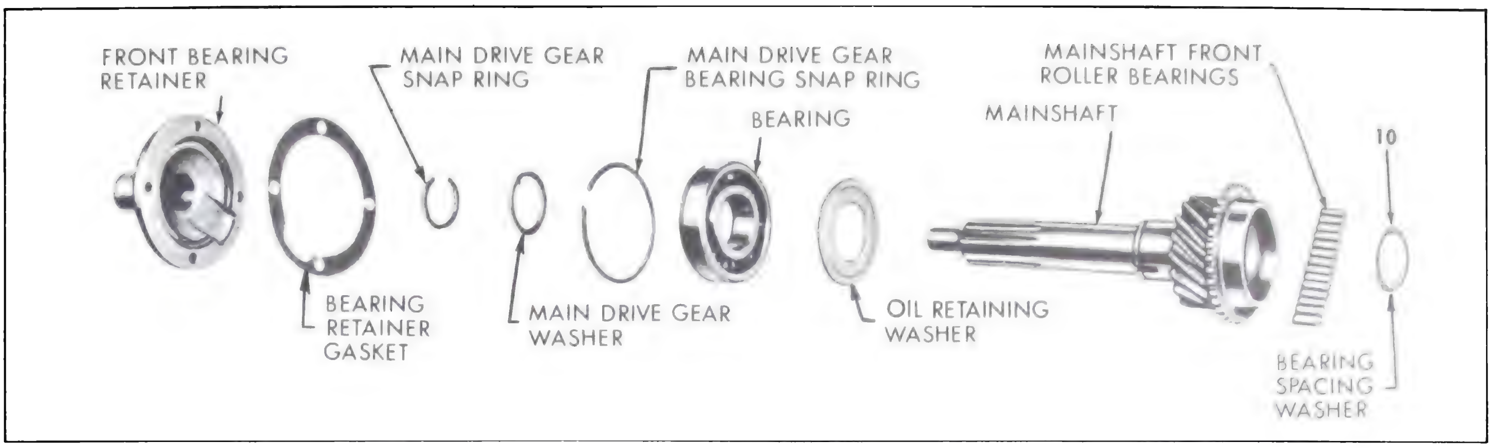


Figure 4-85—Main Drive Gear

29. Remove the mainshaft rear snap ring. See Figure 4-90.

30. Press rear bearing from mainshaft.

b. Cleaning and Inspection

Transmission Case

Wash the transmission case inside and out with a cleaning solvent and inspect for cracks. Inspect the front face which fits against the clutch housing for burrs and if any are present, dress them off with a fine cut mill file.

Front and Rear Bearings

1. Wash the front and rear bearings thoroughly in a cleaning solvent.

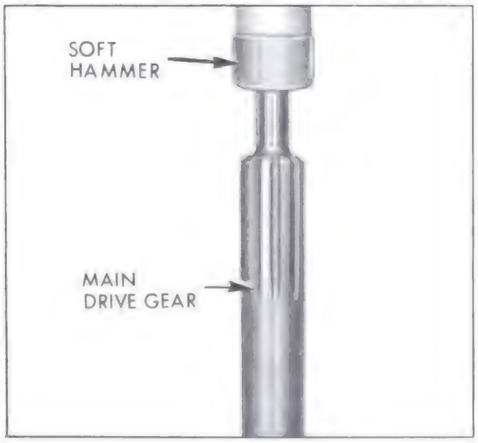


Figure 4-86—Removing Main Drive Gear

2. Blow out bearing with compressed air.

CAUTION: Do not allow the bearings to spin but turn them slowly by hand. Spinning bearings will damage the races and balls.

3. Make sure the bearings are clean, then lubricate them with light engine oil and check for roughness. Roughness may be determined by slowly turning the outer race by hand.

Bearings, Rollers and Spacers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft at the same time and replace as necessary. Replace all worn parts.

Gears

Inspect all gears and replace all that are worn or damaged.

c. Clutch Keys and Springs Replacement

1. Push the hub from the sliding sleeve. The keys will fall free and the springs may be easily removed.

2. Place the two springs in position (one on each side of hub), so a tanged end of each spring falls into the same keyway in the hub. Place the keys in position and, holding them in place, slide the hub into the sleeve as shown in Figure 4-91.

d. Transmission Assembly

Mainshaft Assembly

1. Using J-8853, press on the rear bearing with the snap ring groove toward the front of the transmission. See Figure 4-92. Firmly seat bearing against the shoulder on the mainshaft.

2. Install snap ring in groove in mainshaft behind rear bearing. See Figure 4-93.

NOTE: Always use a new snap ring when reassembling transmission and do not expand snap ring further than is necessary for assembly.

3. Install rear bearing retainer. Spread snap ring in rear bearing

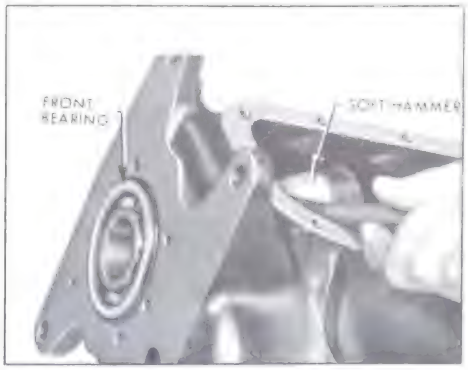


Figure 4-87—Removing Main Drive Gear Bearing

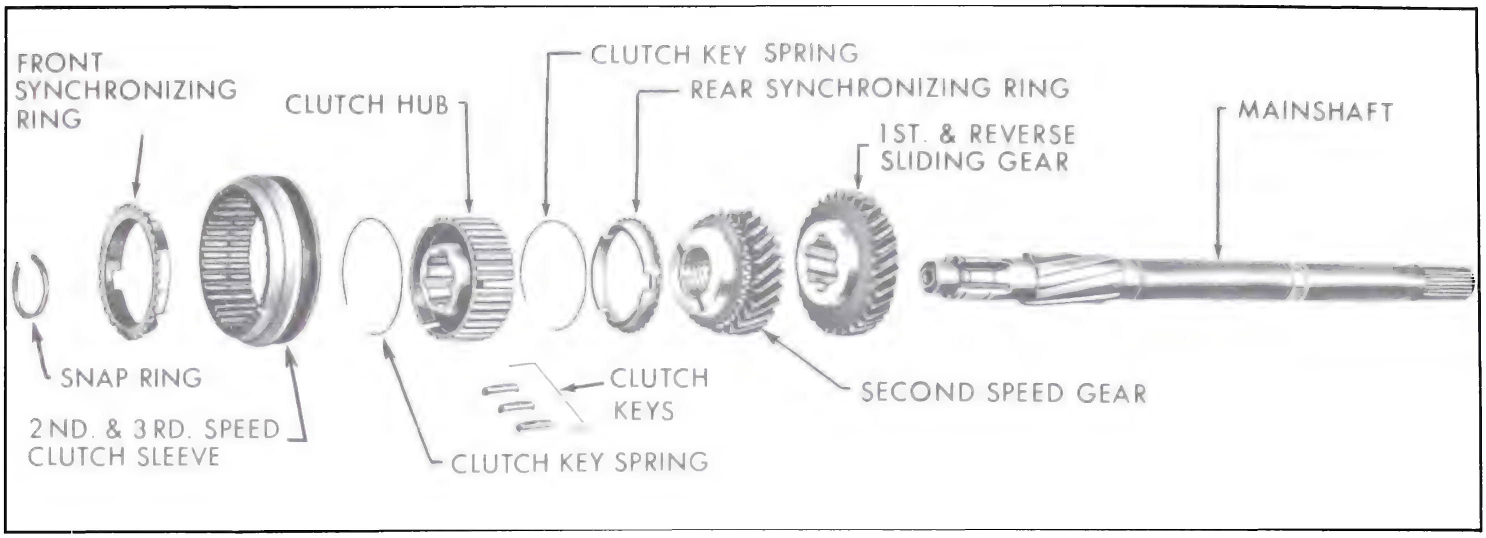


Figure 4-88—Mainshaft Assembly

retainer to allow snap ring to drop around rear bearing. Press on the end of mainshaft until snap ring engages groove in the rear bearing retainer.

4. Install 1st-reverse sliding gear on mainshaft. See Figure 4-94.

5. Install second speed gear, hub forward, over front end of mainshaft. See Figure 4-95.

6. Install 2nd-3rd speed clutch sleeve on clutch hub as shown in Figure 4-96.

7. Place synchronizing ring on rear of sleeve and hub assembly,

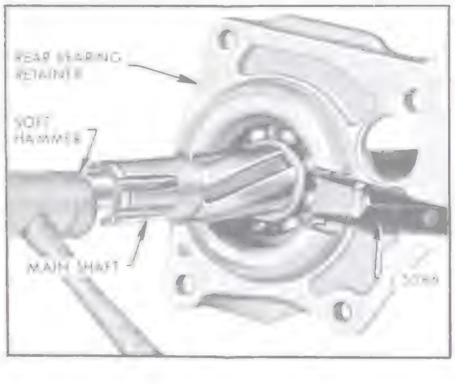


Figure 4-89—Spreading Rear Bearing Snap Ring

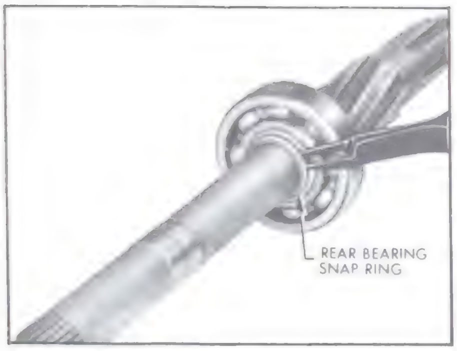


Figure 4-90—Removing Rear Bearing Snap Ring

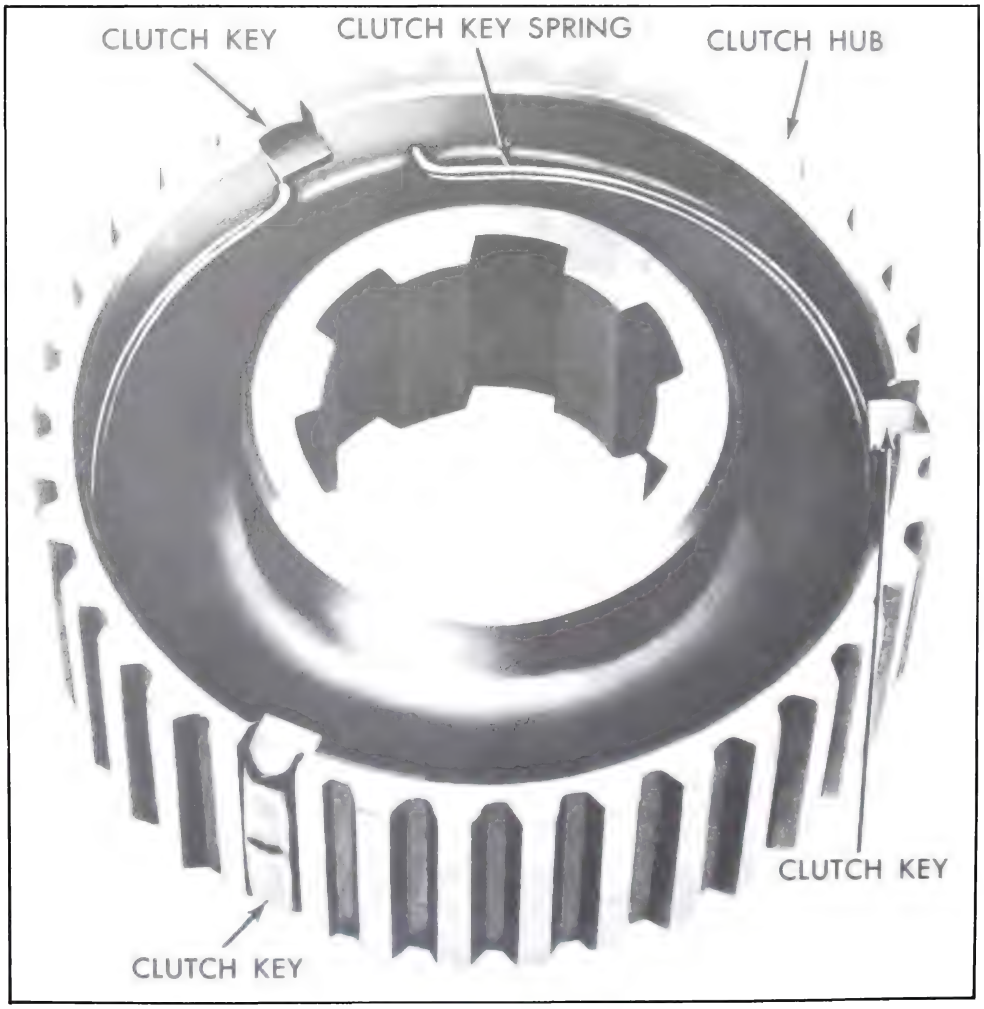


Figure 4-91—Clutch Hub Assembly

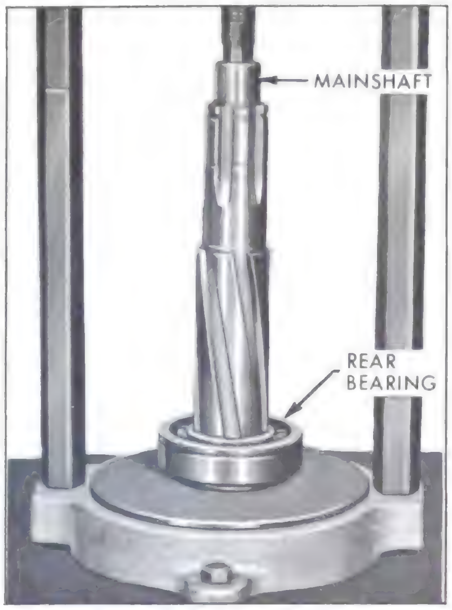


Figure 4-92—Installing Rear Bearing

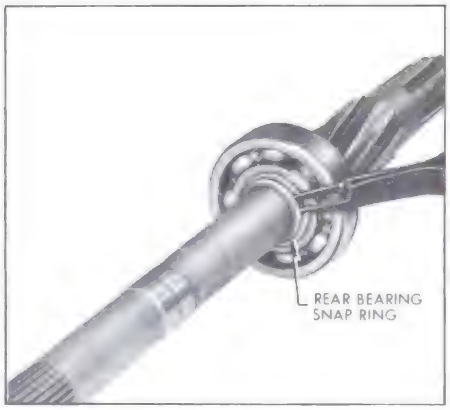


Figure 4-93—Installing Rear Bearing Snap Ring

making sure slots in ring are aligned with clutch keys.

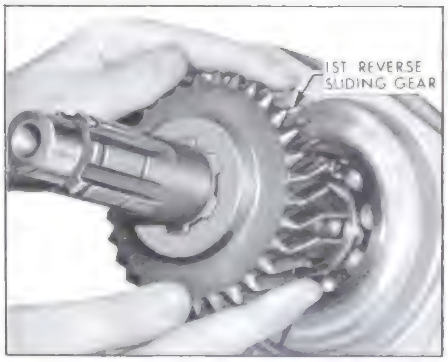


Figure 4-94—Installing 1st-Reverse Sliding Gear

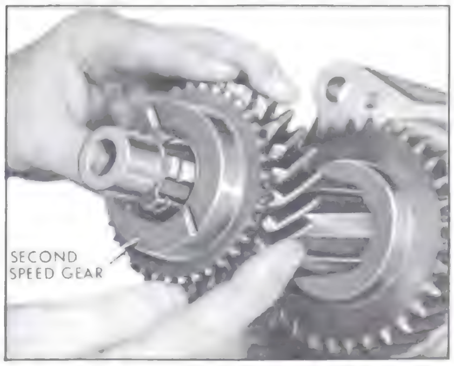


Figure 4-95—Installing Second Speed Gear

8. Install sleeve, hub, and synchronizing ring assembly on mainshaft. See Figure 4-96.

9. Secure clutch hub with retaining snap ring. See Figure 4-97.

10. Press speedometer drive gear onto mainshaft, using Press Plate J-8853. See Figure 4-98.

11. Position the speedometer gear 7-1/2" from the rear of the gear to the rear of mainshaft.

12. Countergear Assembly - Steps 12-18.

13. Install roller spacer in countergear.

14. Using heavy grease to retain the rollers, install 20 rollers in either end of the countergear, two .050" spacers, 20 more rollers, then one .050" spacer.

Install in the other end of countergear, 20 more rollers and another .050" spacer. See Figure 4-99.

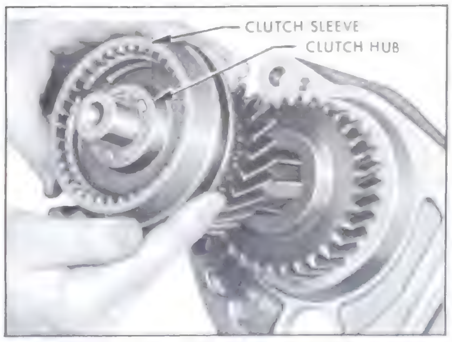


Figure 4-96—Installing 2nd & 3rd Speed Clutch Hub & Sleeve

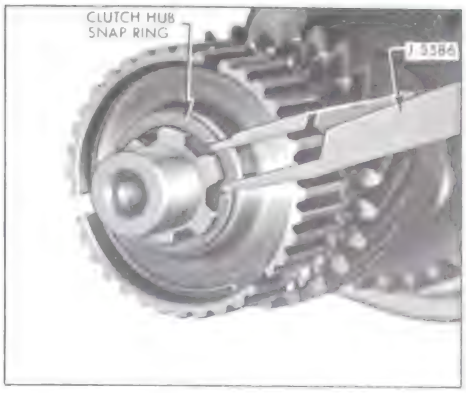


Figure 4-97—Clutch Hub Snap Ring

15. Place large bronze thrust washer at front end of countergear, tang facing out so that it will seat in groove at front of case. Retain with heavy grease.

16. Place smaller bronze thrust washer against rear of countergear, tangs facing gear and seated in grooves. Retain with grease.

17. Through rear of case, insert countergear assembly, large gear end toward front of case. Rest countergear assembly on bottom of case.

Figure 4-98—Speedometer Drive Gear

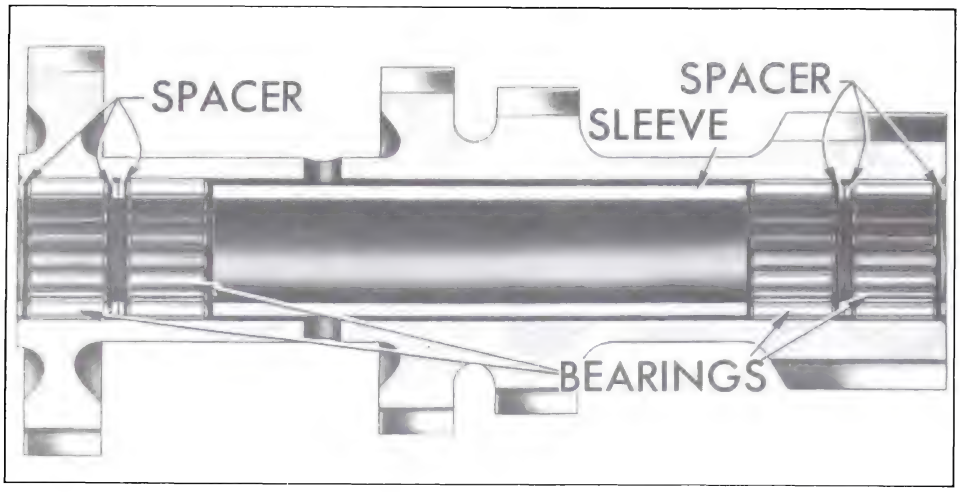


Figure 4-99—Countergear

18. Place steel thrust washer at rear of countergear between bronze thrust washer and case, positioning tang on steel thrust washer in groove in case.

19. Install oil retaining washer on main drive gear, depressed side up. See Figure 4-100.

20. Press bearing onto main drive gear (snap ring groove to front). See Figure 4-101.

21. From inside case, push main drive gear assembly through opening in front of case. Using a soft hammer, tap assembly from rear until bearing attains proper position for installation of snap ring.

Figure 4-100—Installing Oil Retaining Washer

22. Install snap ring in groove of bearing and tap front end of shaft until snap ring rests firmly against face of case.

23. Install main drive gear washer against bearing inner race. See Figure 4-102.

24. Secure main drive gear in place by installing main drive gear snap ring in groove provided in main drive gear. See Figure 4-103.

25. Install front bearing retainer and gasket, making certain oil groove in retainer is lined up with oil outlet hole in case.

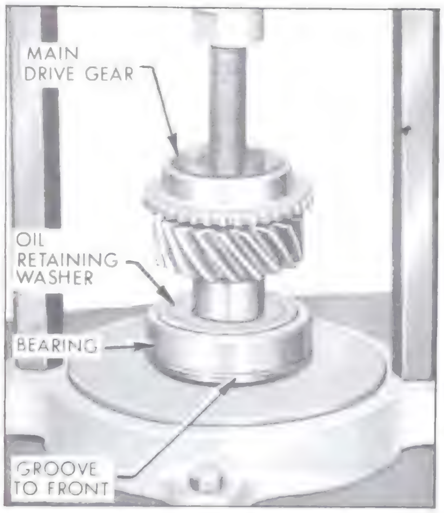


Figure 4-101—Installing Front Bearing

Figure 4-102—Main Drive Gear Washer Installation

26. Coat bore at rear end of main drive gear with heavy lubricant and insert the 14 needle roller bearings in bore.

27. Install bearing spacing washer. See Figure 4-104.

28. Position reverse idler gear in rear of case, chamfer on teeth toward front and, from rear, start idler gear shaft through case and gear.

29. Place lock key in notch at rear of idler gear shaft, then drive shaft into case until lock key seats against cutout in case and shaft is flush with rear of case.

30. Set transmission on its top side to assist in installing mainshaft assembly.

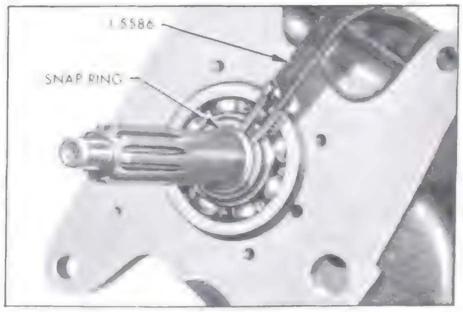


Figure 4-103—Installing Main Drive Gear Snap Ring

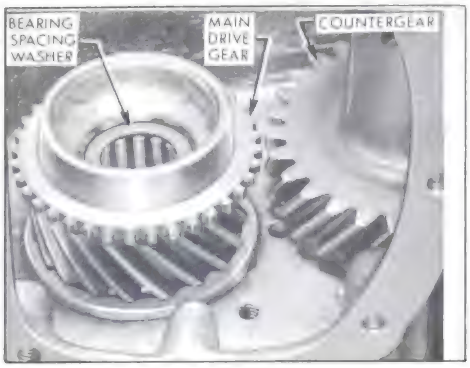


Figure 4-104—Installing Bearing Spacer

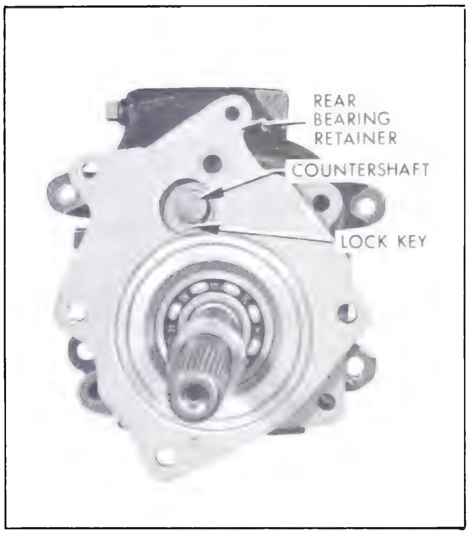


Figure 4-105—Rotating Rear Bearing Retainer

31. Using heavy grease, place gasket in position on front face of rear bearing retainer.

32. Lightly lubricate inner surface of front synchronizing ring and install on hub of main drive gear, positioning one clutch key

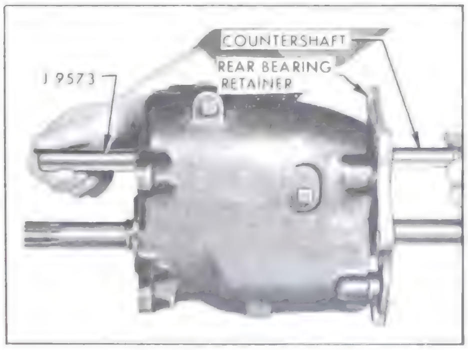


Figure 4-106—Removing J-9573

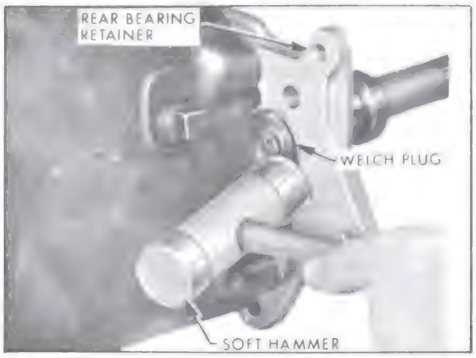


Figure 4-107—Installing Welch Plug

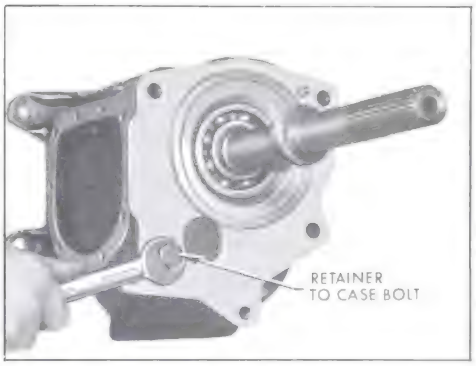


Figure 4-108—Retainer to Case Bolt

slot so that it is visible from side opening in case.

33. Carefully install mainshaft through opening in rear of case, making certain front end of mainshaft enters roller bearings at rear of main drive gear and clutch key slot of synchronizing ring lines up with clutch key.

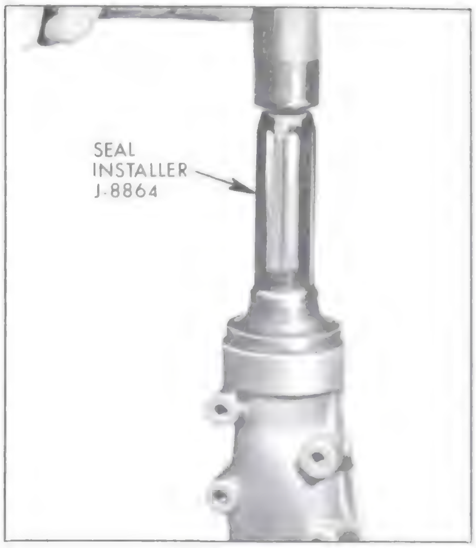


Figure 4-109—Installing Case Extension Oil Seal

NOTE: <u>When installing mainshaft into transmission, allow approximately 1/2" clearance between transmission case and rear bearing retainer.</u>

34. Turn transmission over so countergear shaft can be installed.

35. With rear bearing retainer rotated as shown in Figure 4-105, insert countershaft through exposed shaft opening in rear of case, making certain the shaft passes through both thrust washers before it enters countergear.

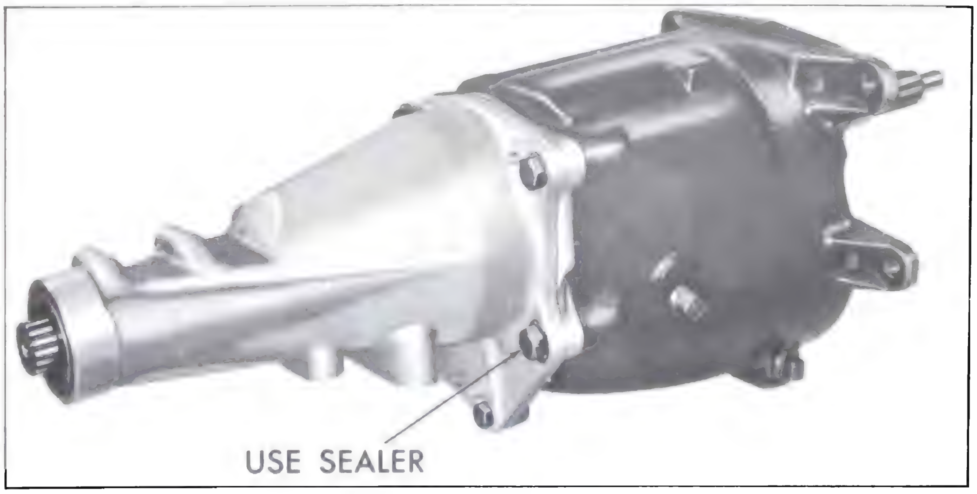


Figure 4-110—Sealing Case Extension Attaching Bolt

NOTE: Rotating main drive gear back and forth will help in aligning countergear thrust washer with shaft opening in case.

36. Slide countershaft through countergear, forcing Tool J-9573 out opening at front of case. See Figure 4-106.

37. Before countershaft is driven fully into place, install lock key (retain key is countershaft with heavy grease) in notch at rear of shaft, then drive shaft in until lock key seats against cutout in case.

38. Rotate rear bearing retainer as shown in Figure 4-107 and install welch plug.

39. Align rear bearing retainer with transmission case. With a soft hammer, tap end of mainshaft to seat rear bearing retainer with transmission case.

40. Install retainer to case bolt. See Figure 4-108.

41. Check both synchronizing rings through side opening in case to insure freedom of movement. Place clutch in neutral position.

42. With clutch in neutral, install shift rods. Lower transmission side cover into place. Install attaching bolts and tighten evenly to avoid side cover distortion. Use suitable sealer when installing the lower right bolt.

43. Install new oil seal in rear bearing retainer, using Seal Installer J-8864. See Figure 4-109. Lightly coat seal with gear lubricant.

44. Install three extension and retainer to case attaching bolts (torque to 35 to 45 ft. lbs.) and two extension to retainer attaching bolts (torque to 20 to 30 ft. lbs.). Use a suitable sealer on the lower right attaching bolt as viewed from rear. See Figure 4-110.

45. Install front companion flange. See Figure 4-111.

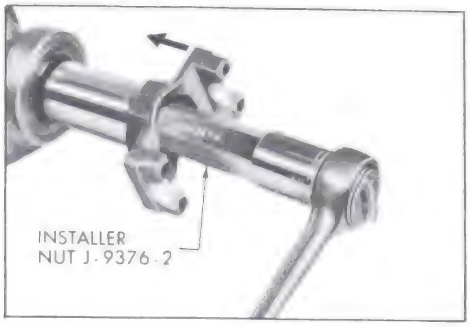


Figure 4-111—Installing Front Companion Flange

SECTION 4-E

4-SPEED SYNCHROMESH TRANSMISSION

CONTENTS OF SECTION 4-E

4-26 4-SPEED TRANSMISSION SPECIFICATIONS

a. Tightening Specifications

Part		Thread Size	Torque Ft. Lbs.
Bolt	Front Bearing Retainer to Transmission Case	5/16-18	15-20
Bolt	Side Cover Bolts	5/16-18	15-20
Nut	Shift Lever to Shaft	5/16-18	12-18
Bolt	Transmission to Flywheel Housing	1/2 -13	45-60
Bolt	Flywheel Housing to Engine	3/8 -16	30-35

b. 4-Speed Synchromesh Transmission Specifications

Mounting	Unit With Engine
Oil Capacity, Pints	2
Type of Gearing	All Helical
Transmission Ratios - 4400	
Fourth	1.00 to 1
Third	1.51 to 1
Second	1.89 to 1
First	2.54 to 1
Reverse	2.61 to 1
Transmission Ratios - 4600	
Fourth	1.00 to 1
Third	1.31 to 1
Second	1.64 to 1
First	2.20 to 1
Reverse	2.26 to 1

c. Speedometer Gear

Speedometer Worm on Main Shaft	Press Fit
Teeth on Worm for Axle Ratios 3.08 and 3.36	8
Teeth on Worm for Axle Ratios 2.78	9
Teeth on Worm for Axle Ratios 3.90 and 4.30	6

4-27 4-SPEED TRANSMISSION

DESCRIPTION

The 4-speed synchromesh transmission is solidly bolted to the rear face of the flywheel upper housing to form a unit assembly with the engine. The transmission main drive gear shaft extends through the clutch driven plate into a bronze bushing seated in the rear end of the engine crankshaft. The front bearing retainer projects into a bore in the flywheel housing, serving as a pilot to center the transmission with the engine crankshaft.

a. Transmission Gears and Shafts

The transmission main drive gear is supported by a ball bearing which is a slip fit in the front wall of the transmission case. The inner race of the bearing is held tight against a shoulder on the drive gear. The outer race of the

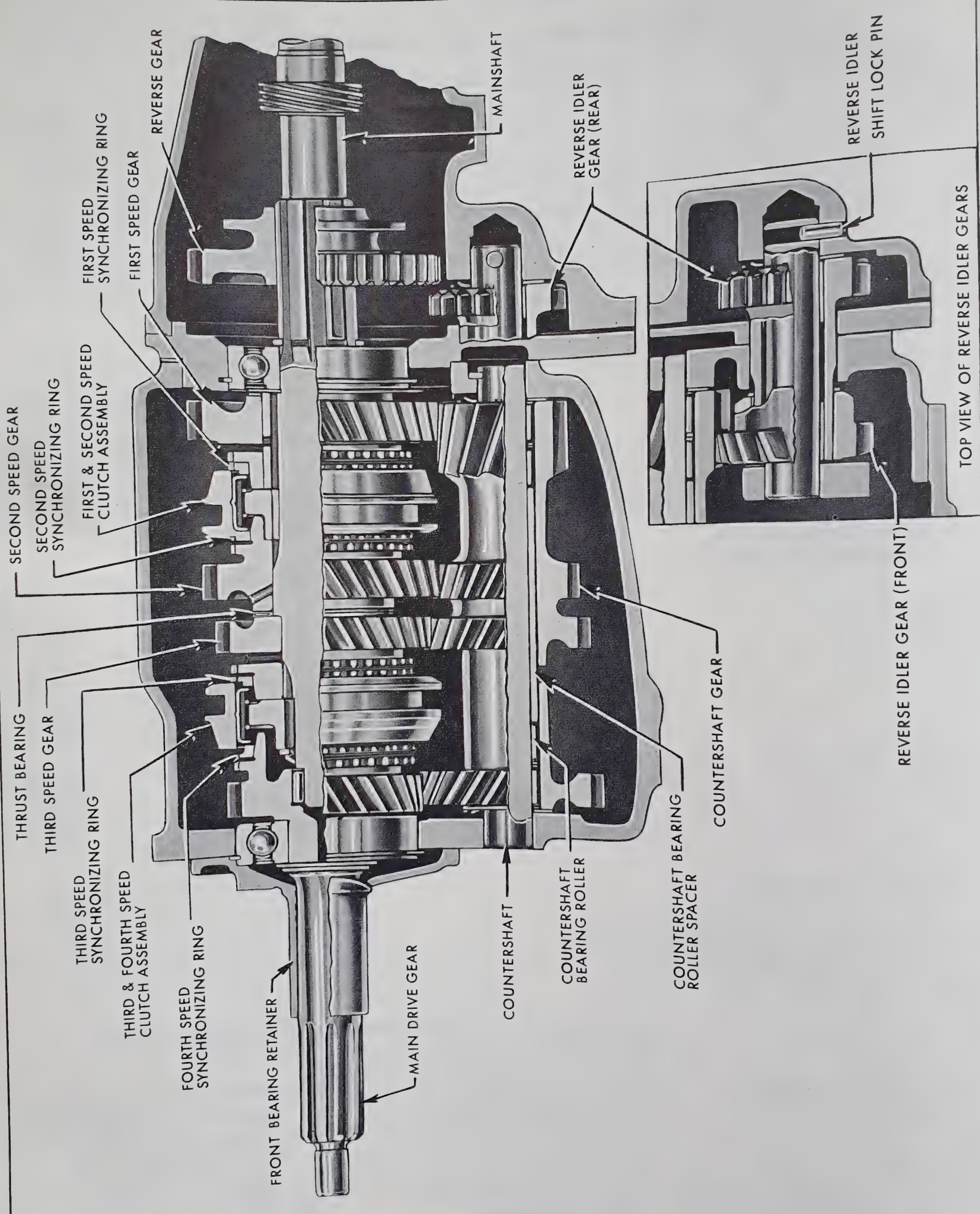


Figure 4-112—Four Speed Transmission

bearing is grooved for a snap ring which fits between the transmission case and the front bearing retainer to hold the bearing and main drive gear in place. See Figure 4-112.

The front end of the transmission main shaft is piloted in the bored rear end of the main drive gear by 14 needle rollers. The rear end of the main shaft is supported by a heavy-duty bearing identical to the one which supports the main drive gear. The inner race of the rear bearing is grooved for a snap ring which fits in the rear bearing retainer. The outer race of the bearing is retained by a snap ring in a groove in the shaft.

The transmission countergear is carried on a double row of needle rollers on each end of the countershaft. A tubular spacer separates the four sets of needle rollers and two washer-type spacers separates each set of needle rollers. Two spacers are located at the outer ends of each set to hold the rollers in position. End thrust is taken on thrust washers located between the ends of the gear and the front and rear of the case.

The two-piece reverse idler gear is carried on bronze bushings while thrust is taken on thrust washers located between the front of the gear and the back of the reverse idler thrust boss and between the rear of the gear and the reverse idler shaft boss in the case extension.

b. Gear Ratios

All four forward gears are provided with synchronizing clutches which can be engaged while the car is in motion. Closely spaced gear ratios of 2.20 (first), 1.64 (second), 1.31 (third) and 1.00 (fourth) provide excellent ratio matching with minimum loss of engine speed at the shift points. Reverse gear (2.26 ratio) is not synchronized; therefore, vehicle must be brought to a complete stop before engaging reverse gear.

The transmission may be used as an aid in deceleration by downshifting in sequence without double clutching or gear clashing, due to all forward speeds being synchronized.

c. Speedometer Gears

The speedometer driving worm gear is pressed on the transmission main shaft. When changing rear axle ratios it is necessary to change the driven gear, and on some axle ratios it is necessary to change the driving worm gear. The speedometer driven gear assembly consists of a sleeve, a gear and shaft, and "O" ring sleeve seal, a sleeve retainer and bolt. The driven gear sleeve is a slip fit in the rear extension. The sleeve is held in place by a retainer which fits into a slot in the sleeve and is bolted to the rear bearing retainer. The gears are lubricated by splash from the transmission. The speedometer cable is attached to the sleeve by a threaded sleeve on the cable casing.

d. Front Companion Flange

The front companion flange is splined to the rear end of the transmission mainshaft and is retained by a heavy steel washer and bolt. An oil seal is located in the rear end of the case extension.

e. Shift Linkage

Gearshifting is manual through a floor-type gear shift lever which activates shift control rods connected to the transmission cover shifter levers for first through fourth gears, and to the reverse lever located in the case extension. The shifter lever to the rear of the transmission cover controls the first and second speed gears, while the lever to the front controls the third and fourth speed gears.

f. Power Flow Through Transmission

1. Operation in Neutral

In neutral, with engine clutch engaged, the drive gear turns the countergear. The countergear then turns the third, second, first, and reverse idler gears. But, because the third and fourth and first and second speed clutch (sleeves) are neutrally positioned, and the reverse speed gear is positioned at the rear, away from the reverse idler gear, power will not flow through the mainshaft. See Figure 4-113.

2. Operation in First

In first speed, the first and second speed clutch (sleeve) is moved rearwards to engage the first speed gear, which is being turned by the countergear. Because the first and second speed clutch (hub) is splined to the mainshaft, torque is imparted to the mainshaft from the first speed gear through the clutch assembly. See Figure 4-114.

3. Operation in Second

In second speed, the first and second speed clutch (sleeve) is moved forward to engage the second speed gear, which is being

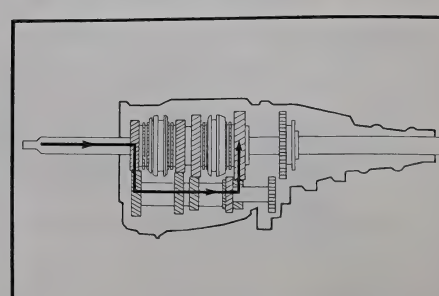


Figure 4-113—Power Flow in Neutral

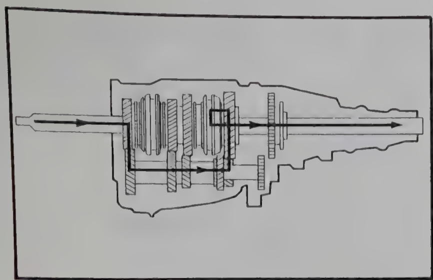


Figure 4-114—Power Flow in First

turned by the countergear. This engagement of the clutch (sleeve) with the second speed gear imparts torque to the mainshaft because the first and second speed clutch (hub) is splined to the mainshaft. See Figure 4-115.

4. Operation in Third

In third speed, the first and second speed clutch assumes a neutral position. The third and fourth speed clutch (sleeve) moves rearward to engage the third speed gear, which is being turned by the countergear. Because the third and fourth speed clutch (hub) is splined to the mainshaft, torque is imparted to the mainshaft from the third speed gear through the clutch assembly. See Figure 4-116.

5. Operation in Fourth

In fourth speed, or direct drive, the third and fourth speed clutch (sleeve) is moved forward to engage the main drive gear and the first and second speed clutch remains in a neutral position. This

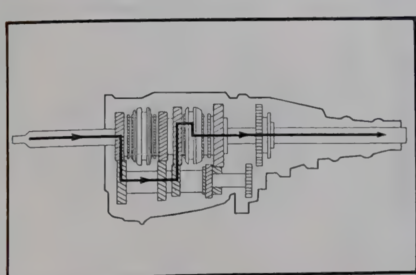


Figure 4-115—Power Flow in Second

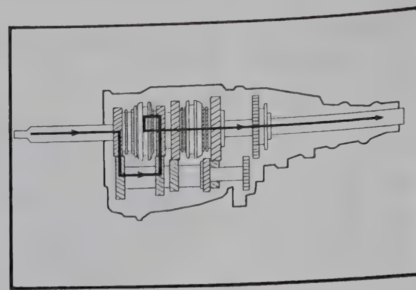


Figure 4-116—Power Flow in Third

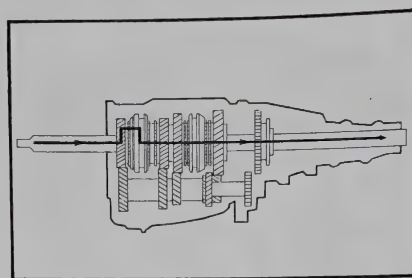


Figure 4-117—Power Flow in Fourth

engagement of the main drive gear with the third and fourth speed clutch assembly imparts torque directly to the mainshaft. See Figure 4-117.

6. Operation in Reverse

In reverse speed, both clutch assemblies assume a neutral position. The reverse speed gear is moved forward to engage the rear reverse idler gear, which is being turned by the countergear. Because the reverse speed gear is splined to the mainshaft, this engagement causes the mainshaft to turn; however, because power flows from main drive gear to countergear and through reverse idler gear to reverse speed gear,

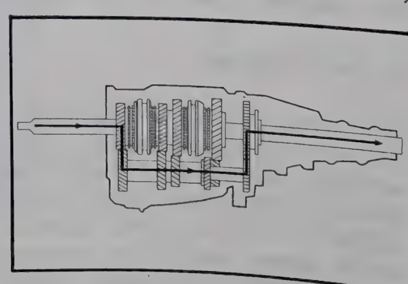


Figure 4-118—Power Flow in Reverse

the direction of rotation will be opposite that of the engine. See Figure 4-118.

4-28 TRANSMISSION TROUBLE DIAGNOSIS

a. Hard Shifting and Block-out

Hard shifting may be caused either by improper linkage adjustment or by conditions in the transmission assembly.

b. Noise in Neutral

With the car standing, engine running, the transmission in neutral, the transmission parts in operation are: main drive gear and bearing, countergear and bearings, reverse idler gear, first speed gear, second speed gear, third speed gear. Disengaging the clutch will stop movement of all these parts. By disengaging and engaging the clutch it can be determined whether the noise originates in these transmission parts and whether the noise is normal. Noise in neutral in the form of a constant regular click is usually caused by a nicked gear or bearing.

c. Gear Jump-out

In any case of gear jump-out, first check the adjustment of the gear shift control mechanism. Make certain that interlock balls have full engagement in the notches in the shift shaft cam through all speed positions including neutral.

Gear jump-out in fourth speed may be caused by misalignment between the flywheel housing hole and the crankshaft. Check bore and face run out. It must not exceed .005".

Gear jump-out in any transmission speed position may be caused

by loose fit of the bearings or bushings involved, a weak interlock spring, loose fit of the synchronizing hub on the mainshaft, loose fit of the first-reverse gear on the mainshaft, worn teeth on mating gears. All items should be carefully inspected.

d. Scored or Broken Gear Teeth

Gear teeth will be seriously damaged and possibly broken by failure of the car operator to fully engage the gears on every shift before engaging the clutch and applying engine power.

Considerable damage to gears and bearings may result from running at abnormal speeds in reverse, first and second speed gears. This practice is also detrimental to the engine.

4-29 TRANSMISSION SIDE COVER REMOVAL AND INSTALLATION

NOTE: It is not necessary to remove transmission from vehicle for inspection or replacement of parts in transmission side cover assembly, but the side cover assembly itself must be removed from the transmission case.

a. Removal

1. Remove drain plug at the bottom of transmission and drain lubricant.

2. Disconnect first, second, third and fourth shift rods from levers.

3. Remove transmission side cover assembly from transmission case.

4. Remove the outer shifter lever nuts and lock washers and pull levers from shafts.

5. Carefully push the shifter shafts into cover, allowing the detent balls to fall free, then remove both shifter shafts.

6. Remove interlock sleeve, interlock pin and poppet spring.

7. Replace necessary parts.

b. Installation

1. Install interlock sleeve and one shifter shaft. Place steel detent into sleeve followed by poppet spring and interlock pin.

2. Start second shifter shaft into position and place second detent ball on poppet spring. Compress ball and spring with screwdriver and push the shifter shaft fully in.

3. With transmission in neutral and shifter forks and levers in place, lower side cover into place. Install attaching bolts, using sealer and lower right bolt (see Figure 4-119), and tighten evenly.

4-30 REMOVAL AND INSTALLATION OF 4-SPEED TRANSMISSION

a. Removal of Transmission

1. If transmission is to be disassembled, drain transmission lubricant.

2. Mark propeller shaft and front companion flange so that these parts can be reassembled in same relative position.

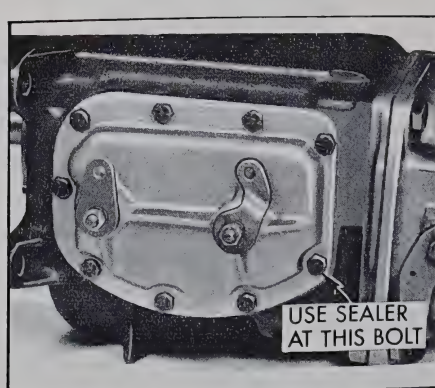


Figure 4-119—Transmission Side Cover Assembly

3. Remove the U-bolts attaching the propeller shaft to front companion flange. Slide propeller shaft rearward as far as possible for working clearance.

4. Remove gear shift knob.

5. Remove floor shift trim Bezel.

6. Disconnect speedometer cable from transmission.

7. Disconnect shift control rods from the shifter levers at the transmission.

8. Loosen all three exhaust pipe joints so that transmission and rear end of engine can be lowered.

9. Remove two bolts attaching transmission mounting pad to transmission support. Leave mounting pad bolted to transmission. See Figure 4-120.

10. Place a flat wood block on jack. Place jack under engine pan until transmission mounting pad just clears transmission support.

11. Remove four bolts attaching transmission support to body members. Remove support, then lower jack so that transmission will clear underbody during removal.

12. Remove upper left transmission to flywheel housing bolt and install a J-1126 guide pin; remove lower right bolt and install a guide pin.

13. Remove other two transmission to flywheel housing bolts. Slide transmission straight back until drive gear shaft is clear of flywheel housing, then lower transmission.

CAUTION: If weight of transmission is allowed to rest on main drive gear while drive gear splines are in clutch driven plate, driven plate may be damaged.

b. Installation of Transmission

1. Lightly coat splines on end of main drive gear with Lubriplate for a distance of approximately

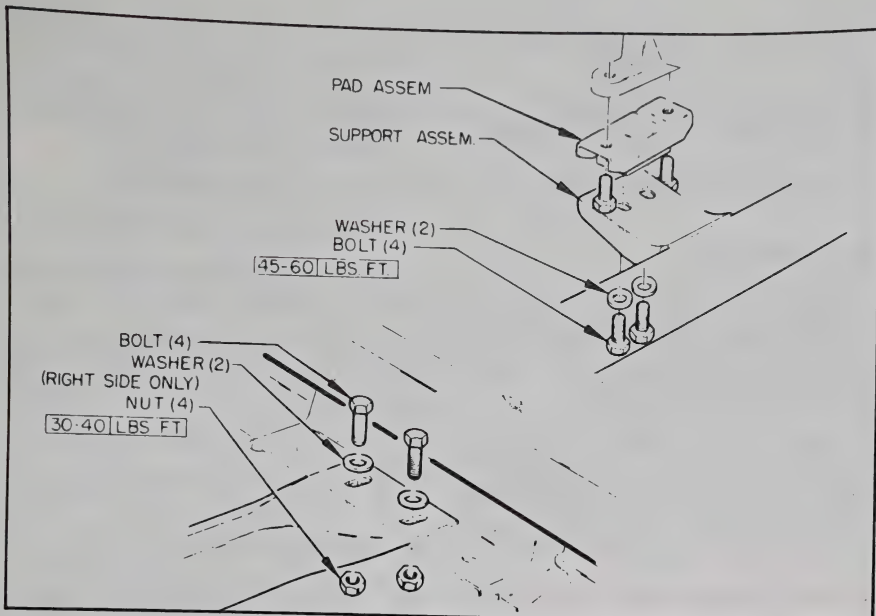


Figure 4-120—Four Speed Transmission Mounting

1 inch. Fill groove in inner surface of throw-out bearing with wheel bearing grease.

2. Make certain that front face of transmission case and rear face of flywheel housing are absolutely clean. Install J-1126 guide pin in lower right hole of flywheel housing.

3. Lift transmission into place on guide pins and slide straight forward, meanwhile fully supporting transmission. Rotate companion flange as required to engage drive gear with driven plate splines. CAUTION: If weight of transmission is allowed to rest on main drive gear shaft before shaft engages pilot bushing in flywheel, driven plate may be damaged.

4. Install two transmission to flywheel housing bolts; remove guide pins and install other two bolts. Tighten all four bolts securely.

5. Raise jack under engine pan so that transmission mounting pad will clear transmission support.

6. Install transmission support, leaving four nuts loose. Lower jack so that transmission rests on support.

7. Install two bolts attaching mounting pad to support then tighten all six bolts securely.

8. Align exhaust system, if necessary, and tighten three ball joints.

9. Connect speedometer cable to transmission.

10. Install shift linkage to transmission.

11. Adjust shift linkage as described in Group 4-A.

4-31 DISASSEMBLY OF 4-SPEED TRANSMISSION

1. Remove transmission side cover assembly from transmission case. NOTE: If cover assembly is to be disassembled for inspection or replacement of worn parts, follow procedures 2 through 6, Section 4-36.

2. Remove four bolts from front bearing retainer and remove retainer and gasket.

3. Remove front companion flange. See Figure 4-121.

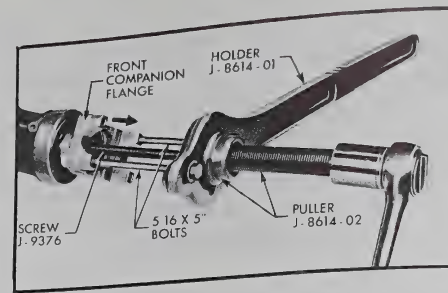


Figure 4-121—Removing Front Companion Flange

4. Drive lock pin up from reverse shifter lever boss, as shown in Figure 4-122, and pull shifter shaft out about 1/8". This disengages the reverse shift fork from reverse gear.

5. Remove five bolts attaching the case extension to the rear bearing retainer. Tap extension with soft

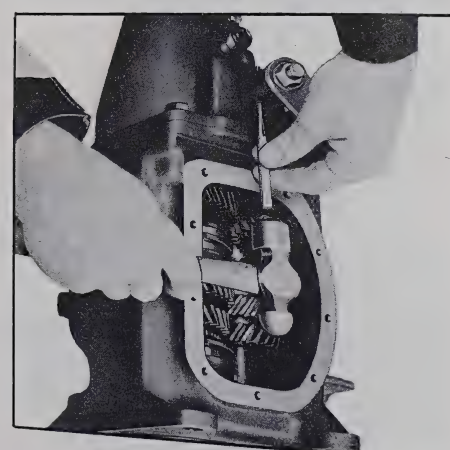


Figure 4-122—Removing Reverse Shifte Shaft Lock Pin

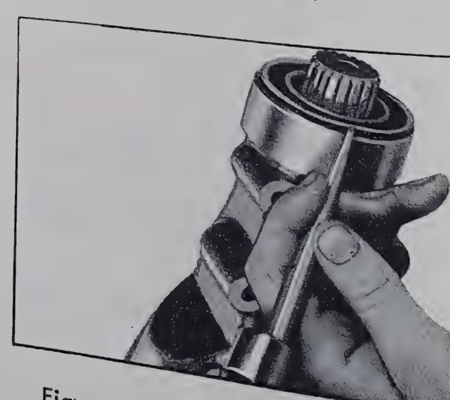


Figure 4-123—Removing Extension Oil Seal

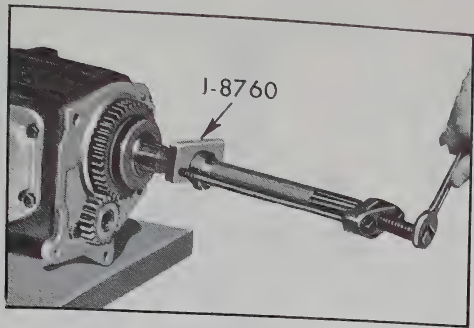


Figure 4-124—Removing Speedometer Gear

hammer in a rearward direction to start. When the reverse idler shaft is out as far as it will go, move extension to left so reverse fork clears reverse gear and remove extension and gasket.

6. Remove rear bearing snap ring on mainshaft.

7. Remove case extension oil seal. See (Figure 4-123).

8. Remove the speedometer gear with J-8760 as shown in Figure 4-124.

9. Remove the reverse gear, reverse idler gear and tanged thrust washer.

10. Remove the self-locking bolt attaching the rear bearing retain-

Figure 4-125—Removing Main Drive Gear Snap Ring

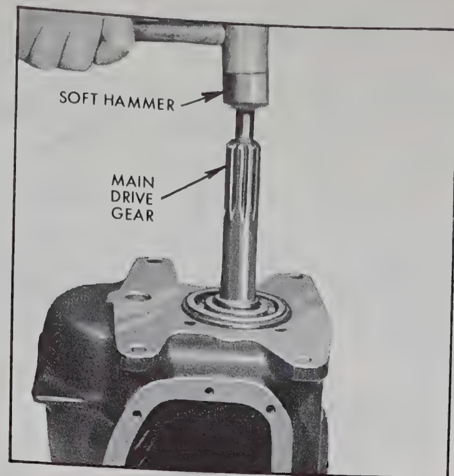


Figure 4-126—Removing Main Drive Gear

er to transmission case. Carefully remove the entire mainshaft assembly.

11. Unload bearing rollers from main drive gear and remove fourth speed synchronizer blocking ring.

12. Lift the front half of reverse idler gear and its thrust washer from case.

13. Remove the main drive gear snap ring (see Figure 4-125), and remove spacer washer.

14. With soft hammer, tap main drive gear down from front bearing as shown in Figure 4-126.

15. From inside case, tap out front bearing and snap ring.

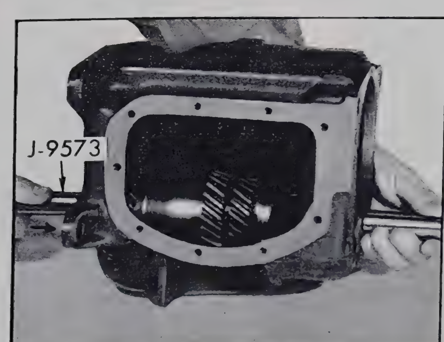


Figure 4-127—Removing Countergear with J-9573

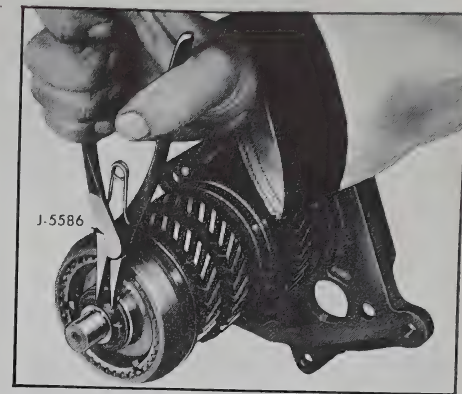


Figure 4-128—Removing Mainshaft Front Snap Ring

16. From the front of the case, remove countershaft (Figure 4-127) with J-9573; then remove the countergear and both tanged washers.

17. Remove the 80 rollers, six .050" spacers and roller spacer from countergear.

18. Remove mainshaft front snap ring (see Figure 4-128), and slide third and fourth speed clutch assembly, third speed gear and synchronizing ring, second and third speed gear thrust washer (needle roller bearing), second speed gear and second speed synchronizing ring from front of mainshaft.

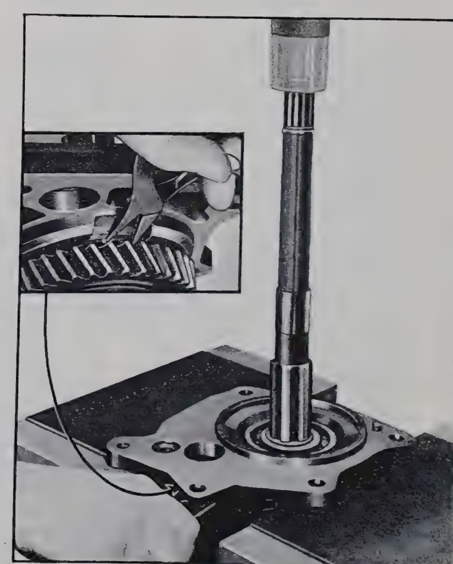
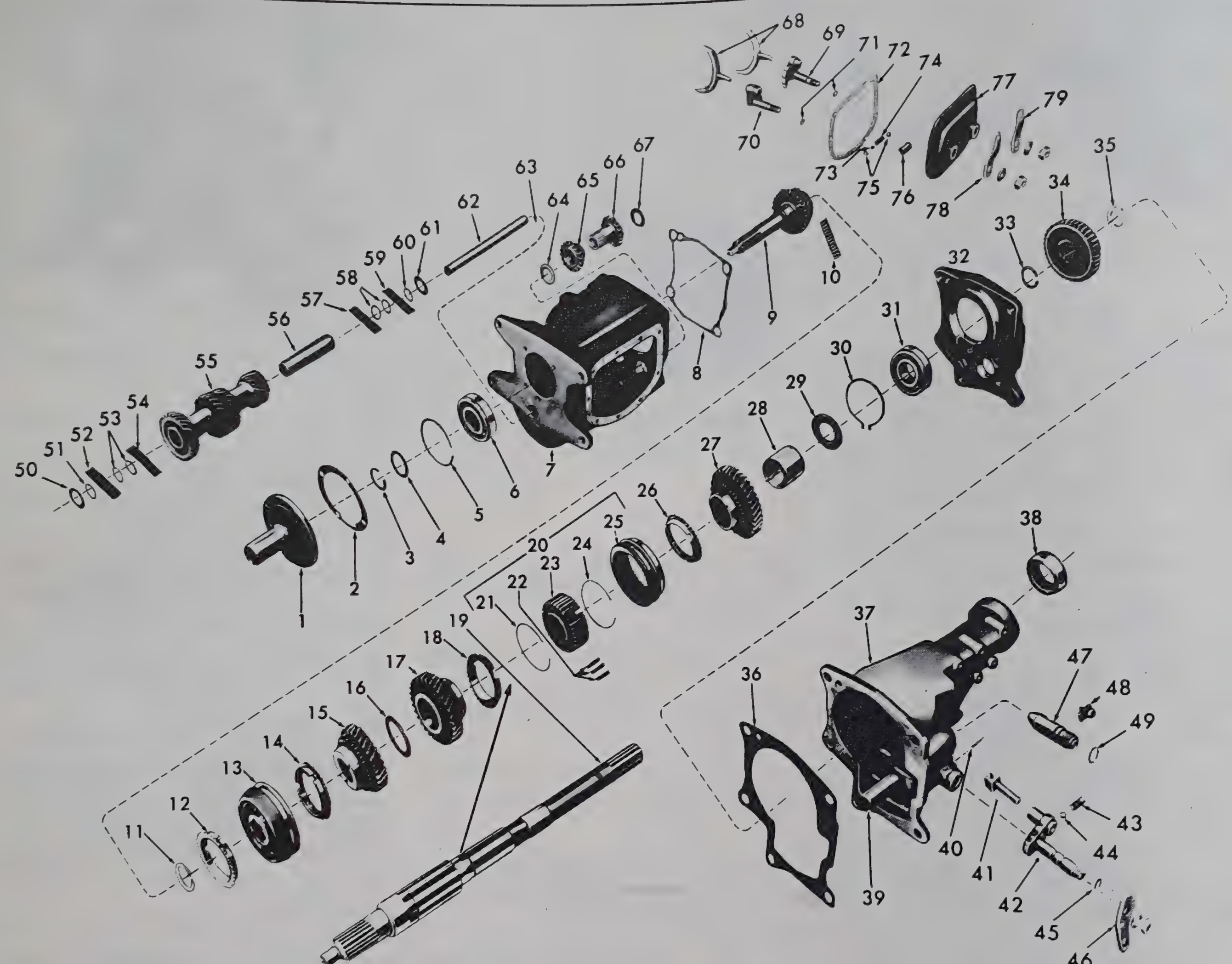


Figure 4-129—Removing Rear Bearing Retainer



1. Bearing Retainer
2. Gasket
3. Selective Fit Snap Ring
4. Spacer Washer
5. Bearing Snap Ring
6. Main Drive Gear Bearing
7. Transmission Case
8. Rear Bearing Retainer Gasket
9. Main Drive Gear
10. Bearing Rollers (14)
11. Snap Ring (.086" to .088")
12. Fourth Speed Gear Synchronizing Ring
13. Third and Fourth Speed Clutch Sliding Sleeve
14. Third Speed Synchronizing Ring
15. Third Speed Gear
16. Second and Third Speed Gear Thrust Washer (Needle Roller Bearing)
17. Second Speed Gear
18. Second Speed Gear Synchronizing Ring
19. Mainshaft
20. First and Second Speed Clutch Assembly
21. Clutch Key Spring
22. Clutch Keys
23. Clutch Hub
24. Clutch Key Spring
25. First and Second Speed Clutch Sliding Sleeve
26. First Speed Gear Synchronizing Ring
27. First Speed Gear
28. First Speed Gear Bushing
29. First Speed Gear Thrust Washer
30. Rear Bearing Snap Ring
31. Rear Bearing
32. Rear Bearing Retainer
33. Selective Fit Snap Ring
34. Reverse Gear
35. Speedometer Drive Gear
36. Rear Bearing Retainer to Case Extension Gasket
37. Case Extension
38. Rear Oil Seal
39. Reverse Idler Shaft
40. Reverse Shifter Shaft Lock Pin
41. Reverse Shift Fork
42. Reverse Shifter Shaft and Detent Plate
43. Reverse Shifter Shaft Ball Detent Spring
44. Reverse Shifter Shaft Detent Ball
45. Reverse Shifter Shaft "O" Ring Seal
46. Reverse Shifter Lever
47. Speedometer Driven Gear and Fitting
48. Retainer and Bolt
49. "O" Ring Seal
50. Tanged Washer
51. Spacer (.050")
52. Bearing Rollers (20)
53. Spacer (2—.050")
54. Bearing Rollers (20)
55. Countergear
56. Countergear Roller Spacer
57. Bearing Rollers (20)
58. Spacers (2—.050")
59. Bearing Rollers (20)
60. Spacer (.050")
61. Tanged Washer
62. Countershaft
63. Countershaft Woodruff Key
64. Reverse Idler Front Thrust Washer (Flat)
65. Reverse Idler Gear (Front)
66. Reverse Idler Gear (Rear)
67. Tanged Thrust Washer
68. Forward Speed Shift Forks
69. First and Second Speed Gear Shifter Shaft and Detent Plate
70. Third and Fourth Speed Gear Shifter Shaft and Detent Plate
71. "O" Ring Seals
72. Gasket
73. Interlock Pin
74. Poppet Spring
75. Detent Balls
76. Interlock Sleeve
77. Transmission Side Cover
78. Third and Fourth Speed Shifter Lever
79. First and Second Speed Shifter Lever

Figure 4-130—4-Speed Synchromesh Transmission

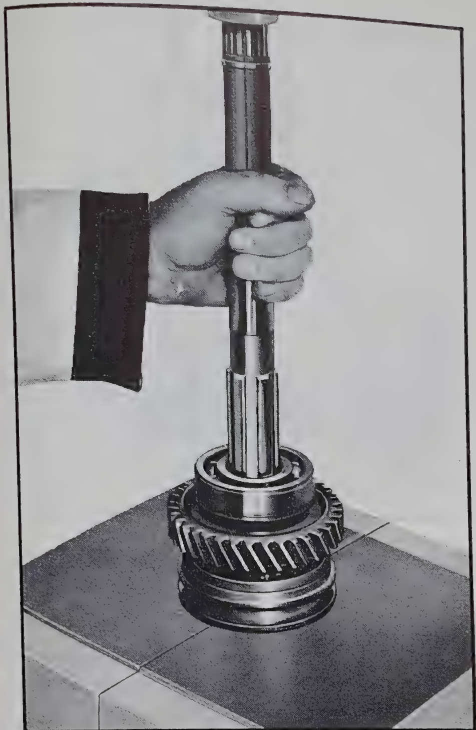


Figure 4-131—Removing Mainshaft from First and Second Speed Clutch Assembly

19. Spread rear bearing retainer snap ring and press mainshaft out of retainer. See Figure 4-129.

20. Remove the mainshaft rear snap ring. Support first and second speed clutch assembly as shown in Figure 4-129, and press on rear of mainshaft to remove shaft from rear bearing, first speed gear, and synchromesh ring first and second speed clutch sliding sleeve and first speed gear bushing.

4-32 CLEANING AND INSPECTION

a. Transmission Case

Wash the transmission case inside and out with a cleaning solvent and inspect for cracks. Inspect the front face which fits against the clutch housing for burrs and if any are present, dress them off with a fine cut mill file.

b. Front and Rear Bearings

1. Wash the front and rear thoroughly in a cleaning solvent.

2. Blow out bearing with compressed air.

NOTE: Do not allow the bearings to spin but turn them slowly by hand. Spinning bearings will damage the race and balls.

3. Make sure the bearings are clean; then lubricate them with light engine oil and check them for roughness. Roughness may be determined by slowly turning the outer race by hand.

c. Bearing Rollers and Spacers

All main drive gear and countergear bearing rollers should be inspected closely and replaced if they show wear. Inspect countershaft at the same time and replace if necessary. Replace all worn parts.

d. Gears

Inspect all gears and replace all that are worn or damaged.

4-33 REVERSE IDLER SHAFT REPLACEMENT

1. With case extension removed from the transmission, drive the reverse idler shaft lock pin into the boss until it falls into the clearance hole in the shaft. See Figure 4-132.

2. Remove shaft from the case extension.

3. Line up the lock pin hole in the shaft with the hole in the boss. Install idler shaft and taper pin in place to lock.

4-34 REVERSE SHIFT AND SEAL REPLACEMENT

1. With case extension removed from transmission, the reverse

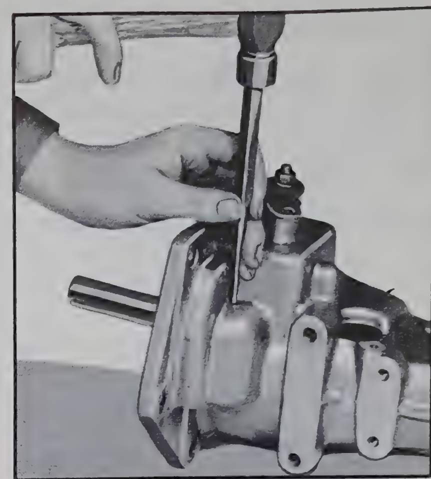


Figure 4-132—Removing Reverse Idler Shaft Lock Pin

shifter shaft lock pin will already be removed.

2. Remove shift fork.

3. Carefully drive shifter shaft into case extension, allowing ball detent to drop into case. Remove shaft and ball detent spring.

4. Place ball detent spring into detent spring hole and start reverse shifter shaft into hole in boss.

5. Place detent ball on spring and, holding ball down with a suitable tool (see Figure 4-133), push the shifter shaft into place and turn; the ball drops into place in detent on shaft detent plate.

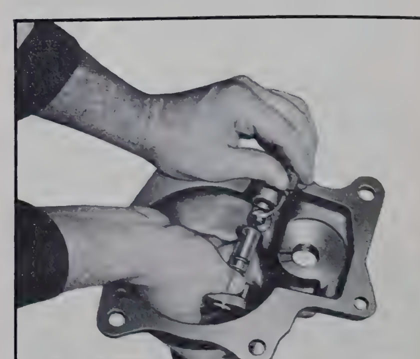


Figure 4-133—Installing Reverse Shifter Shaft

6. Install shift fork.

NOTE: Do not drive the shifter shaft lock pin into place until the extension has been installed on the transmission.

4-35 CLUTCH KEYS AND SPRINGS REPLACEMENT

NOTE: The clutch hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the three keys and two springs may be replaced if worn or broken.

1. Push the hub from the sliding sleeve. The keys will fall free and the springs may be easily removed.

2. Place the two springs in position (one on each side of hub), so a tanged end of each spring falls into the same keyway in the hub. Place the keys in position and, holding them in place, slide the hub into the sleeve.

4-36 ASSEMBLY

a. Mainshaft Assembly

1. From rear of mainshaft, assemble first and second speed clutch assembly to mainshaft (sliding clutch sleeve taper toward the rear, hub to the front) and using J-8853, press the first gear bushing on shaft. See Figure 4-134.

2. Install the first speed gear synchronizing ring so the notches in the ring correspond to the keys in the hub. See Figure 4-135.

3. Install first speed gear (with hub toward the front) and the first speed gear thrust washer. Make certain that the grooves in the washer are facing the first speed gear.

4. Using J-8853, press on the rear bearing with the snap ring groove toward the front of the transmission (see Figure 4-136). Firmly seat bearing against the shoulder on the mainshaft.

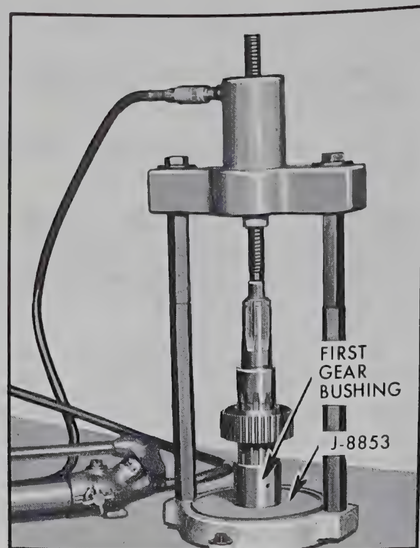


Figure 4-134—Installing First Speed Gear Bushing Using J-8853

5. Install snap ring in the groove in the mainshaft behind the rear bearing.

NOTE: Always use new snap rings when reassembling transmission and do not expand the snap ring further than is necessary for assembly.

6. From the front of the mainshaft, install the second speed gear synchronizing ring so the notches in the ring correspond to keys in the hub.

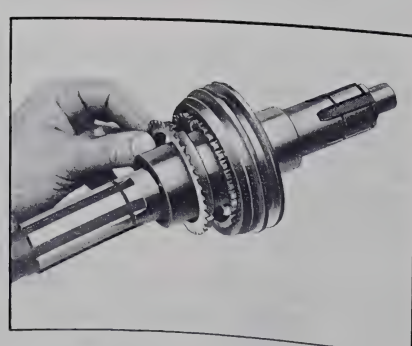


Figure 4-135—Installing Synchronizing Ring

Figure 4-136—Installing Rear Bearing Using J-8853

7. Install the second speed gear (with the hub of the gear toward the back of the transmission) and install the second and third speed gear thrust washer (needle roller bearing).

8. Install the third speed gear (hub to front of transmission) and the third speed gear synchronizing ring (notches to front of transmission).

9. Install the third speed and fourth speed gear clutch assembly (hub and sliding sleeve) with taper toward the front, making sure that the keys in the hub correspond to the notches in the third speed gear synchronizing ring.

10. Install snap ring in the groove in mainshaft in front of the third and fourth speed clutch assembly.

NOTE: If there is no end play, check the thickness of the snap ring just installed; it should be .087" thick. While the snap ring used at this location is NOT selective, it is identical to the selective washers used at the clutch gear and rear bearing locations.

11. Install the rear bearing retainer (see Figure 4-137). Spread the snap ring in the plate to allow the snap ring to drop around the rear bearing and press on the end of the mainshaft until the

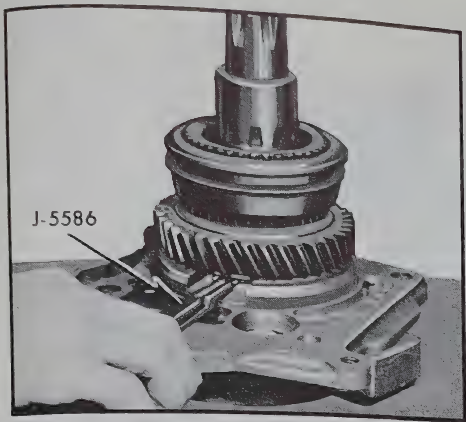


Figure 4-137—Installing Rear Bearing Retainer

snap ring engages the groove in the rear bearing.

12. Install the reverse gear (shift collar to rear).

13. Press speedometer drive gear onto the mainshaft, using a J-8853, press plate. (See Figure 4-138). Position the speedometer gear to get a measurement of 4-1/2" from the center of the gear to the flat surface of the rear bearing retainer. (See Figure 4-139).

14. Replace rear bearing snap ring on mainshaft.

4-37 COUNTER GEAR ASSEMBLY

1. Install roller spacer in countergear.

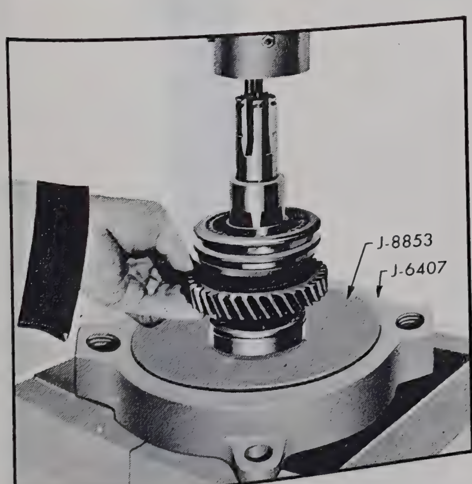


Figure 4-138—Installing Speedometer Drive Gear

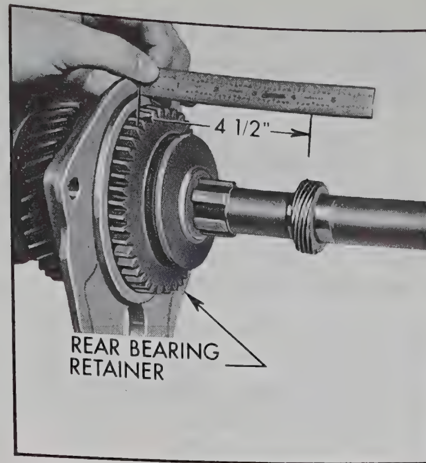


Figure 4-139—Measuring Speedometer Drive Gear

2. Using heavy grease to retain the rollers, install 20 rollers in either end of the countergear, two .050" spacers, 20 more rollers, then one .050" spacer. Install in the other end of the countergear, 20 rollers, two .050" spacers, 20 more rollers, and another .050" spacer. (See Figure 4-141).

4-38 TRANSMISSION ASSEMBLY

1. Rest the transmission case on its side with the side cover opening toward the assembler. Retainer thrust washers on end of countergear with grease.

2. Set countergear in place in bottom of transmission case, making sure that tanged thrust washers are correctly positioned.

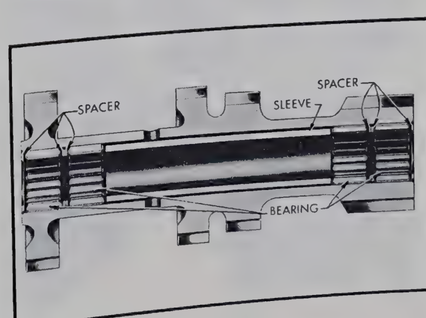


Figure 4-140—Cross Section of Countergear Assembly

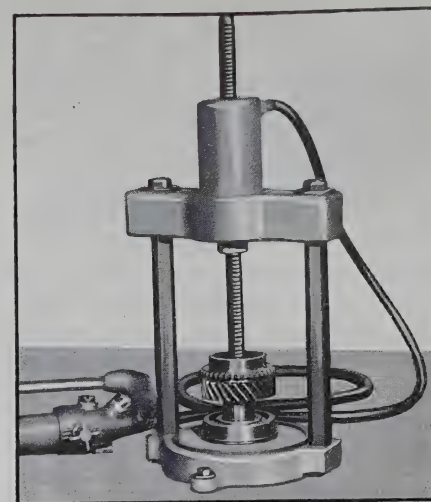


Figure 4-141—Installing Main Drive Gear Bearing

3. Press bearing onto main drive gear (snap ring groove to front), using J-5746 (Figure 4-141). Be sure bearing fully seats against shoulder on gear.

4. Install spacer washer and selective fit snap ring in groove on gear stem.

NOTE: The snap ring is available in three thicknesses: .087", .093", and .099". Use the ring that will produce from zero to .005" clearance between the rear face of the snap ring and the front face of the spacer washer.

5. Install the main drive gear and bearing assembly through the side

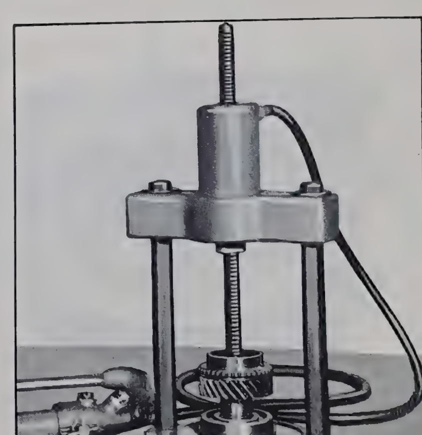


Figure 4-142—Installing Countershaft

cover opening and into position in transmission front bore. Tap lightly into place, if necessary, with a plastic hammer. Place snap ring and spacer in groove in front bearing.

6. With the transmission case resting on its front face, move countergear into mesh with main drive gear. Be sure thrust washers remain in place. Install woodruff key into end of countershaft and press shaft (Figure 4-142) until end of shaft is flush with rear face of transmission case.

7. Attach a dial indicator as shown in Figure 4-143, and check the end play of the countergear. End play must not be more than .025".

8. Install the fourteen roller bearings into the main drive gear, using heavy grease to hold the bearing in place.

9. Using heavy grease, place gasket in position on front face of rear bearing retainer.

10. Install fourth speed synchronizing ring on main drive gear with the notches toward the rear of the transmission.

11. Position the reverse idler gear thrust washer (untanged) on the machined face of the ear cast for the reverse idler shaft. Position the front reverse idler gear on top of the thrust washer with the hub facing forward rear of the case.

12. Lower the mainshaft assembly into the case, making certain that the notches on the fourth speed synchronizing ring correspond to the keys in the clutch assembly. See Figure 4-144.

13. Install the self-locking bolt attaching rear bearing retainer to transmission case, (see Figure 4-145). Torque to 20 to 30 ft. lbs.

14. From the rear of the case, insert the rear reverse idler gear, engaging the splines with the portion of the gear, within the case.

15. Using heavy grease, place gasket into position on rear face of rear bearing retainer.

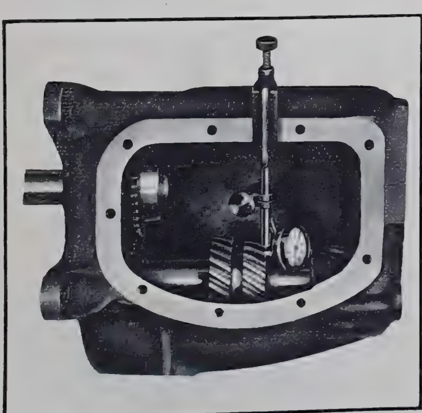


Figure 4-143—Checking Countergear End Play

Figure 4-144—Installing Mainshaft Assembly

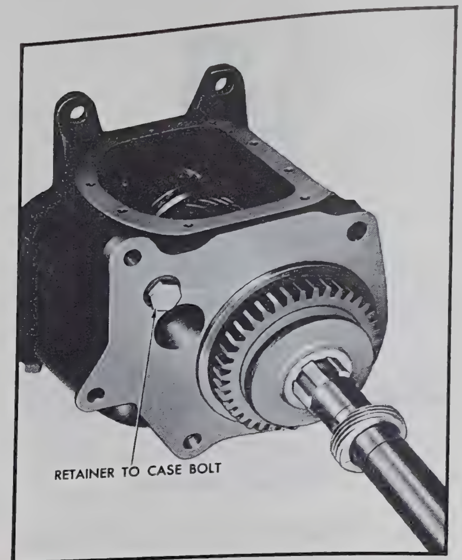


Figure 4-145—Bearing Retainer to Transmission Bolt

16. Using heavy grease, install the remaining thrust washer into place on the reverse idler shaft, making sure tang on the thrust washer is in the notch in the idler thrust face of the extension.

17. Place the two clutches in neutral position. Pull reverse shifter shaft to left side of extension and rotate shaft to bring reverse shift fork as far forward in extension as possible. Start the extension onto the transmission case (Figure 4-147) while slowly pushing

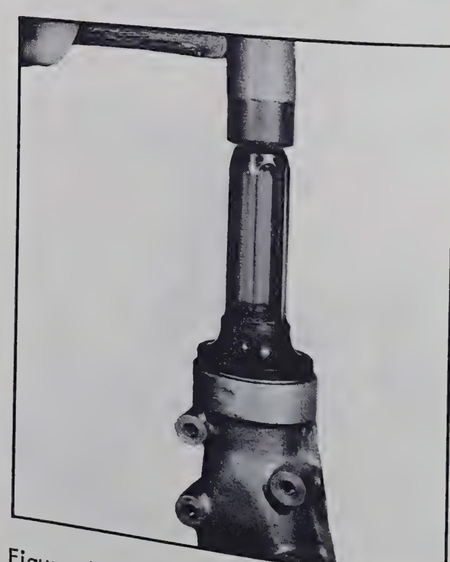


Figure 4-146—Installing Case Extension Oil Seal

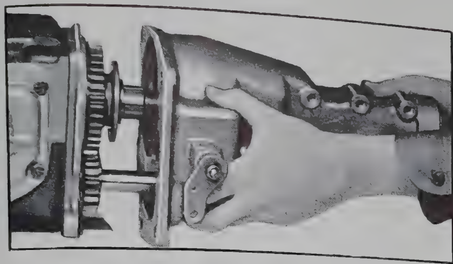


Figure 4-147—Installing Case Extension to Transmission Case

in on the shifter shaft to engage the shift fork with the reverse gear shift collar. When the fork engages, rotate the shifter shaft to move the reverse gear rearward, permitting the extension to slide onto the transmission case.

18. Install new oil seal in rear bearing retainer, using Seal Installer J-8864. See Figure 4-146. Lightly coat seal with gear lubricant.

19. Install three extension and retainer to case attaching bolts (torque to 35 to 45 ft. lbs.) and two extension to retainer attaching bolts (torque to 20 to 30 ft. lbs.). Use suitable sealer on the lower right attaching bolt as viewed from rear. See Figure 4-149.

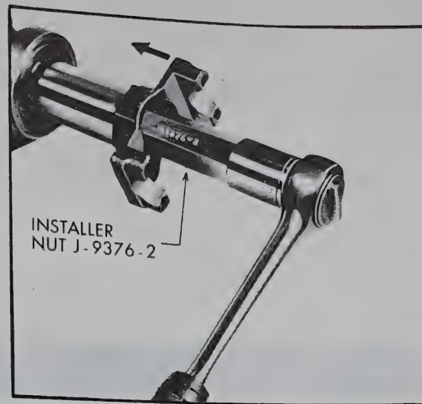


Figure 4-148—Installing Front Companion Flange

20. Push or pull reverse shifter shaft to line up groove in the shaft with the holes in the boss and drive in the lock pin. Install shifter lever.

21. Install the main drive gear bearing retainer, gasket and four attaching bolts, using a suitable sealer on bolts. Torque to 15 to 20 ft. lbs.

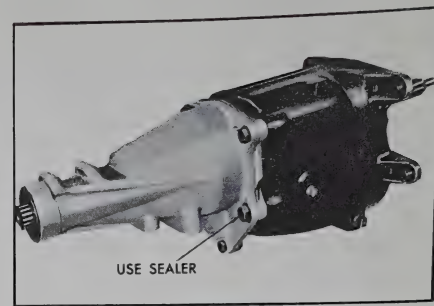


Figure 4-149—Sealing Case Extension Attaching Bolt

22. Install a shift fork in each clutch sleeve.

23. Install Front Companion flange (see Figure 4-148).

24. Place both clutches in neutral, install side cover gasket and carefully lower side cover into place. Install attaching bolts and tighten evenly to avoid side cover distortion. Use suitable sealer when installing the lower right bolt.

NOTE: <u>The transmission should "overshift" slightly in all ranges.</u>

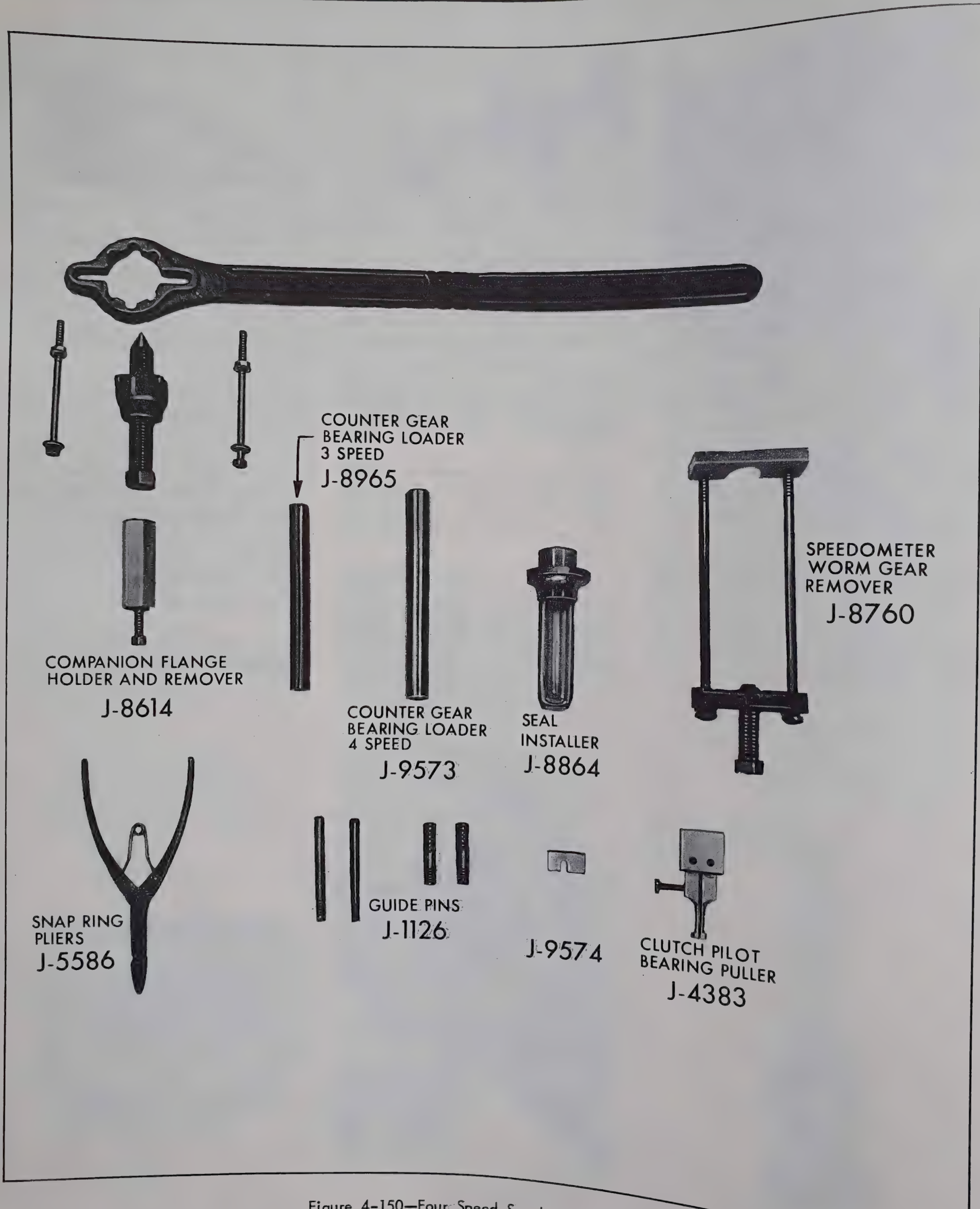


Figure 4-150—Four Speed Synchromesh Tools

GROUP 4A

TRANSMISSION SHIFT LINKAGE

SECTIONS IN GROUP 4A

4A-A 3-SPEED SYNCHROMESH LINKAGE—4400-4600

1. Place transmission in neutral.

2. Loosen all shift rod clamps. See Figure 4A-1.

3. Install J-21618 on mast jacket.

4. Check levers on side of transmission, making sure they are positioned as shown in the illustration.

5. Tighten shift rod clamps. Torque to 10-15 ft. lbs. Do not over-torque.

6. Remove J-21618 from mast jacket.

7. Check for ease of shifting.

4A-B 4-SPEED SYNCHROMESH LINKAGE—4600

a. 4-Speed Synchromesh—4600 Less Console

1. Install guide pin J-21196 in shift linkage at end of shift lever. See Figure 4A-2.

2. Loosen shift rod adjusting clamps to allow shift rods freedom of movement inside swivel.

3. Tighten shift rod adjusting clamps. Torque to 10-15 ft. lbs. Do not over-torque.

4. Remove guide pin J-21196.

5. After shift controls are adjusted to neutral position, hold shift lever in 4th gear by merely resting hand on shift lever to remove all lash in linkage. Then turn "stop" bolt until it contacts shift lever. Torque jam nut to 20-30 ft. lbs. Repeat the same procedure for 3rd gear.

6. Check for ease of shifting.

b. 4-Speed Synchromesh—4600 with Console

1. Loosen carpet from console and install guide pin J-21196 through access hole in left side of console. See Figure 4A-3.

2. Loosen shift rod adjusting clamps to allow shift rods freedom of movement inside swivel.

3. Tighten shift rod adjusting clamps. Torque to 10-12 ft. lbs. Do not over-torque.

4. Remove guide pin J-21196.

5. Check for ease of shifting.

6. Re-install carpet to console.

4A-C SUPER TURBINE "300" LINKAGE ADJUSTMENT

1. Loosen shift rod adjusting clamp nut.

2. Set manual shift control lever in Drive "D" range.

3. Set transmission shift lever in Drive "D" range.

4. Tighten shift rod adjusting clamp nut to 10-15 ft. lbs. torque. See Figure 4A-4.

4A-D SUPER TURBINE "400" LINKAGE ADJUSTMENT

a. Column Shift

1. Loosen shift rod adjusting swivel clamp nut.

2. Set transmission shift lever in Drive "D" range.

3. Set transmission shift control lever in Drive "D" range.

4. Tighten nut on adjusting swivel clamp to 10-15 ft. lbs. torque. See Figure 4A-5.

b. Console Shift

1. Loosen shift rod adjusting swivel clamp nut.

2. Set transmission shift lever in Park "P" detent.

3. Set manual control lever in Park "P" position.

4. Tighten nut on adjusting swivel clamp to 10-15 ft. lbs. torque. See Figure 4A-5.

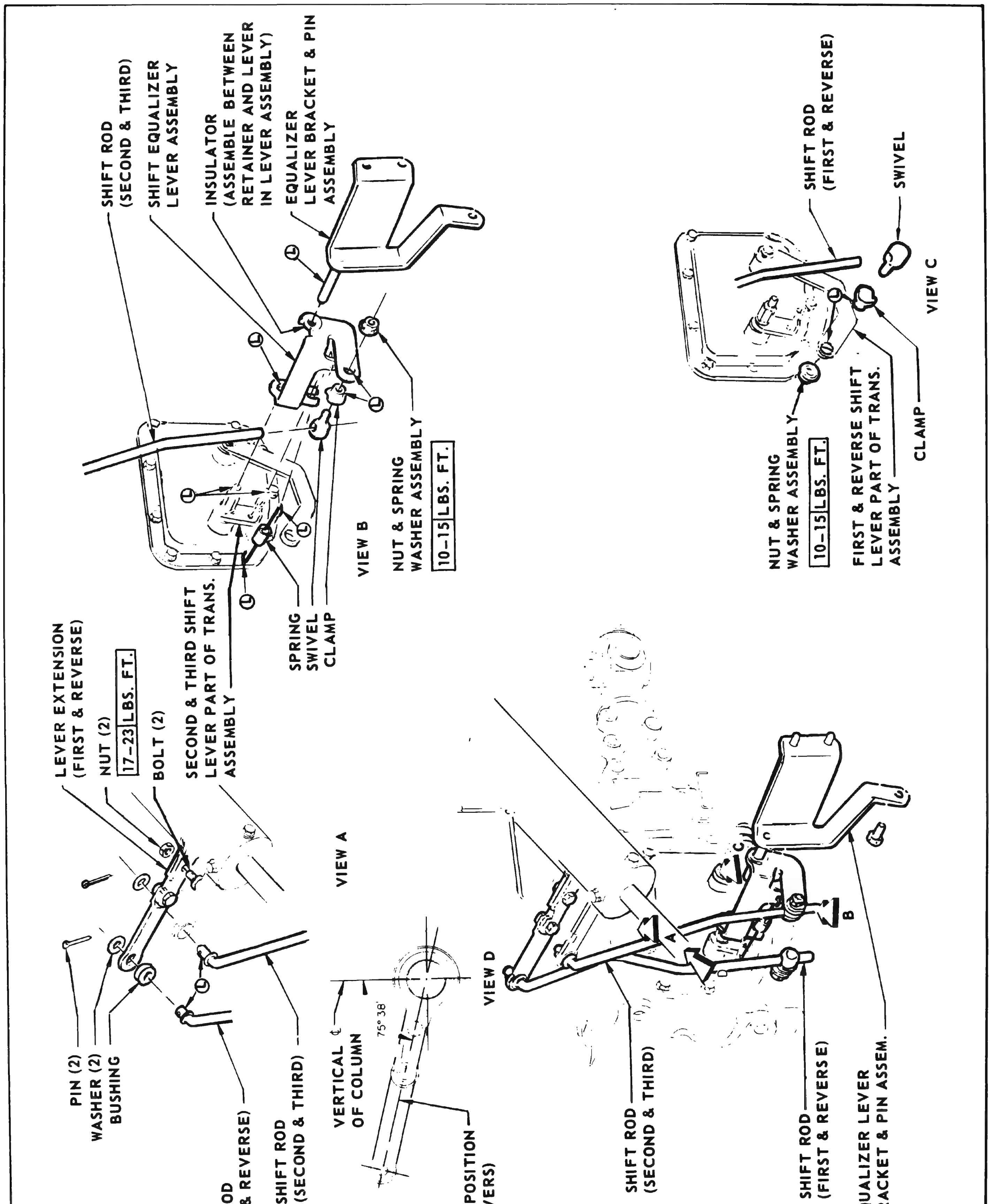


Figure 4A-1—3 Speed Linkage Adjustment - 4400-4600

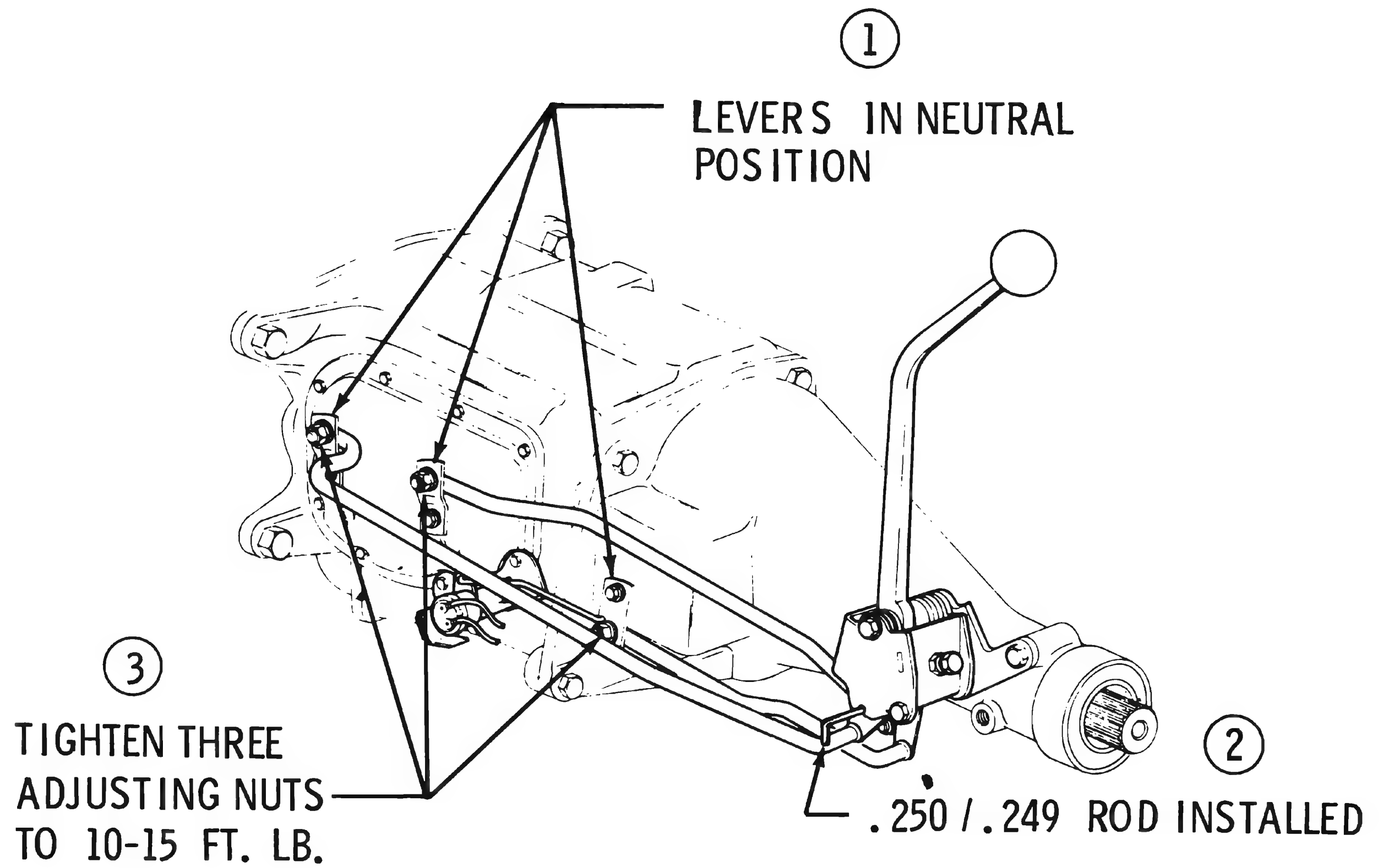


Figure 4A-2—4 Speed Linkage Adjustment - 4600 Less Console

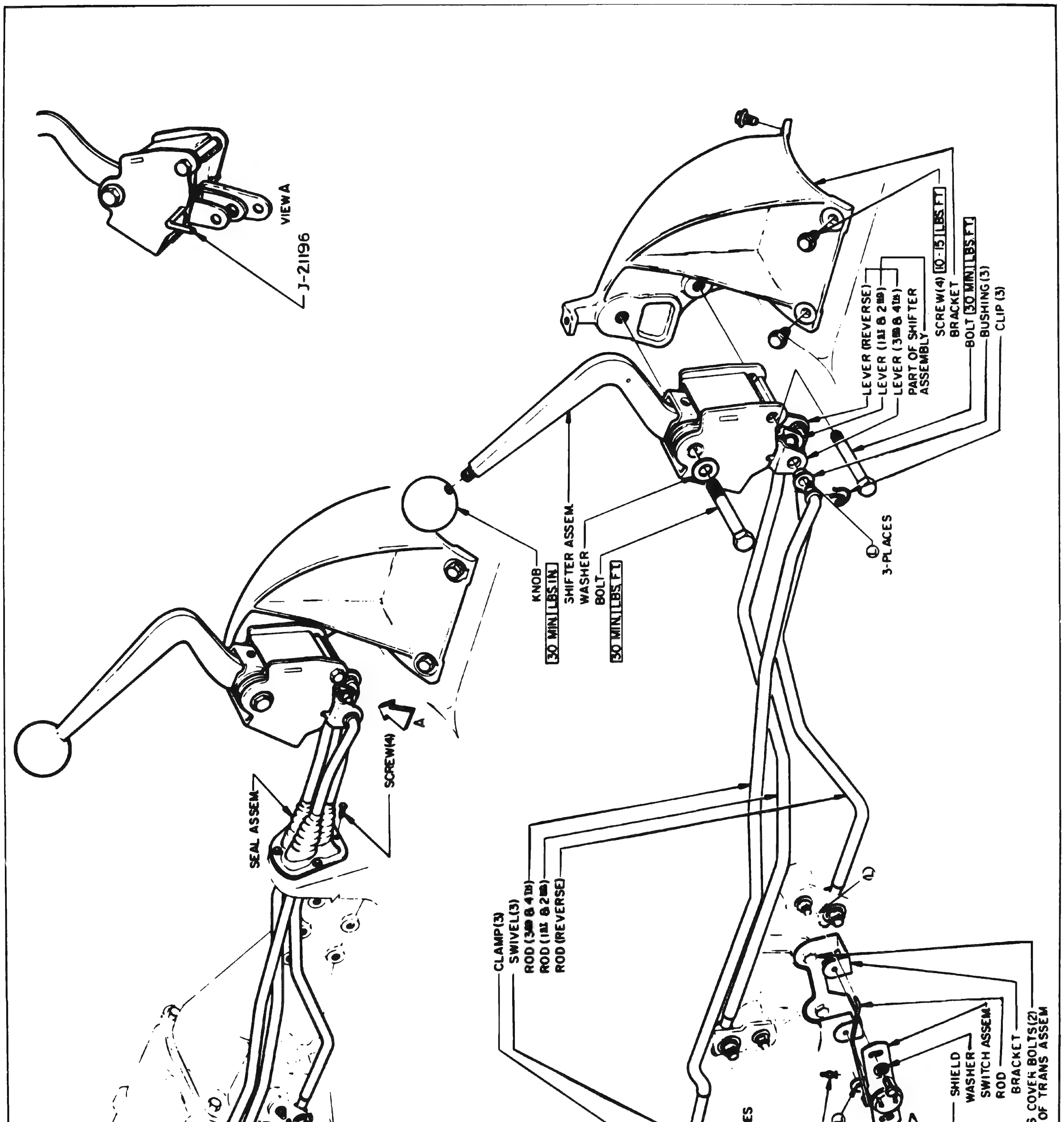


Figure 4A-3—4 Speed Linkage Adjustment - 4600 with Console

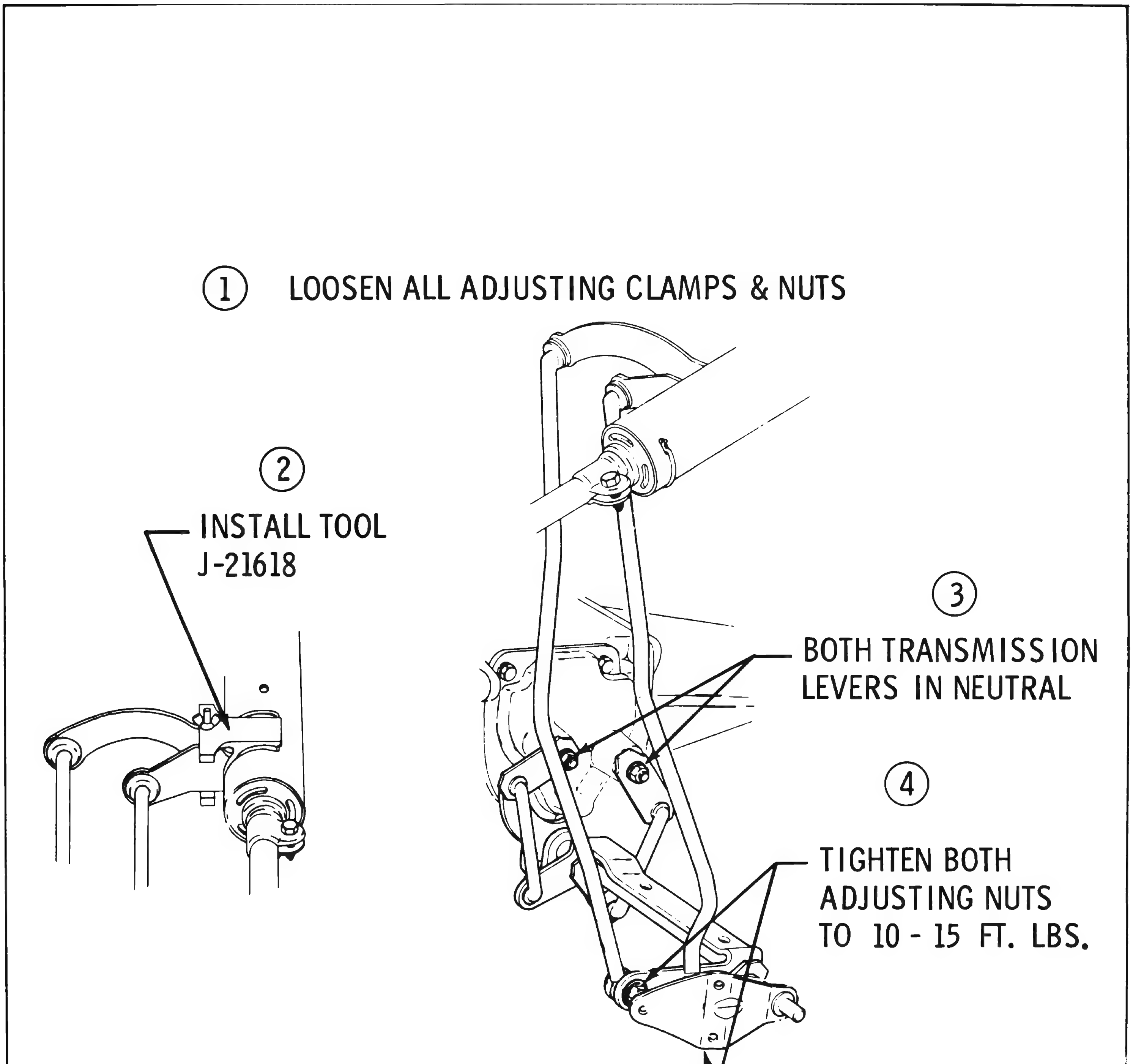


Figure 4A-4-4400 Series Linkage Adjustment

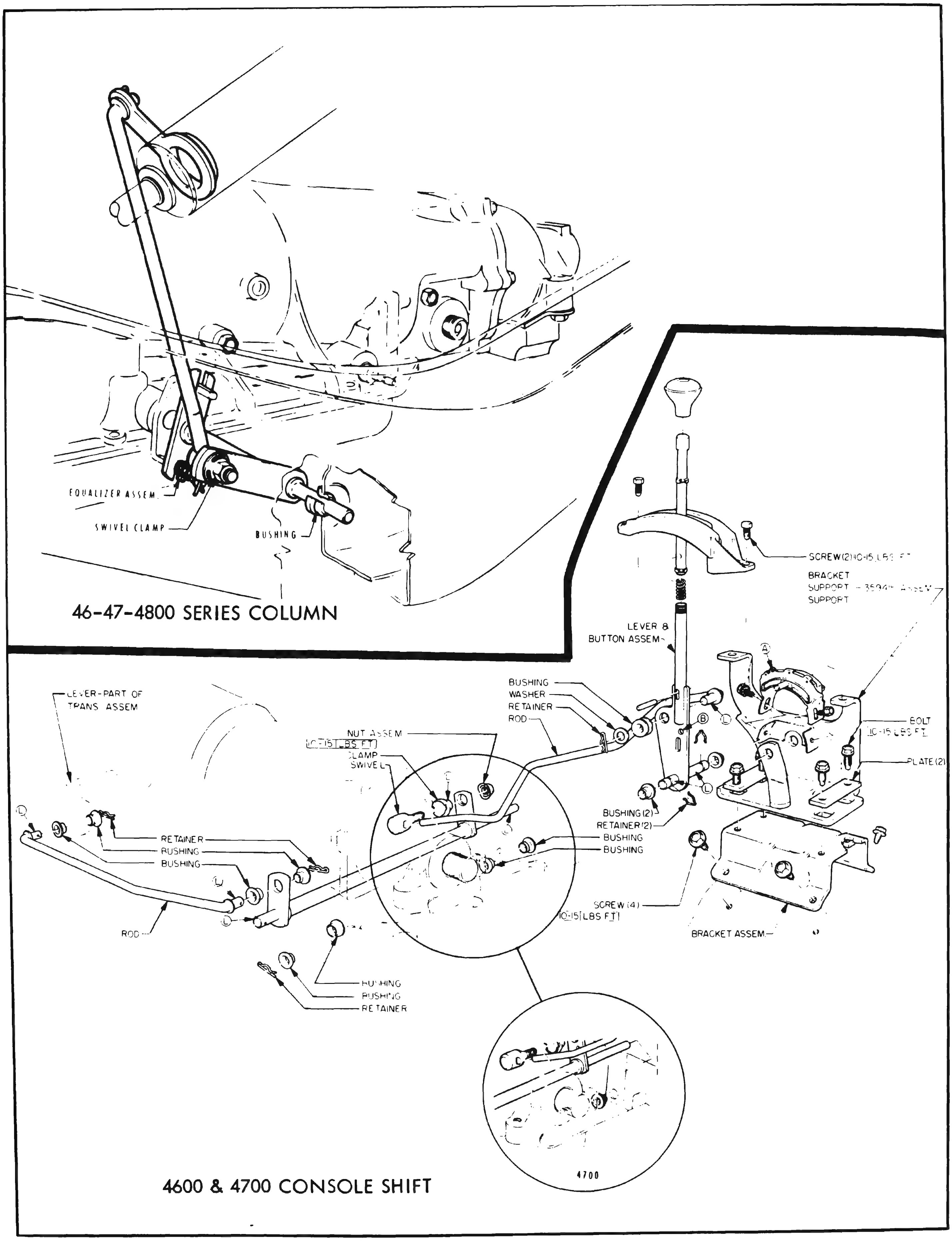


Figure 4A-5—46-47-4800 Series Linkage Adjustment

GROUP 5
SUPER TURBINE "300" AUTOMATIC TRANSMISSION

SECTIONS IN GROUP 5

SECTION 5-A

4000-4100-4300 SUPER TURBINE "300" AUTOMATIC TRANSMISSION SPECIFICATIONS DESCRIPTION AND OPERATION

CONTENTS OF SECTION 5-A

5-1 AUTOMATIC TRANSMISSION GENERAL SPECIFICATIONS

a. Transmission Identification Number

A production identification number is stamped on a metal tag, located in the lower left side of the transmission case.

The production code number is located along the bottom of the tag. Since the production identification number furnishes the key to construction and interchangeability of parts in each transmission, the number should be used when selecting replacement parts as listed in the master parts list. The number should always be furnished on product reports, AFA forms, and all correspondence with the factory concerning a particular transmission.

b. General Specifications

Oil Capacity	18 1/2 Pints
Oil Capacity indicated between Marks on Gauge Rod	1 Pint
Oil Specification	Automatic Transmission Fluid Type A, Suffix A
Drain and Refill Mileage Recommendations Drain Pan and Clean Screen and Pan	24,000 Mi.
Planetary Gearing Type	Compound
Number of Pinions	3 Short 3 Long

5-2 AUTOMATIC TRANSMISSION TIGHTENING SPECIFICATIONS

Use a reliable torque wrench to tighten the attaching bolts or nuts of the parts listed below.

NOTE: These specifications are for clean and lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque ft. lbs.
Bolt	Case to cylinder block	3/8 -16	30-40
Screw-tapping	Converter cover pan to transmission case	1/4 -20	8-12
Pipe fitting	Water cooler pipes to transmission case	1/4 -18	20-30
Nut	Nut for low band adjusting screw	7/16-20	20-30
Bolt	Pump body to pump cover	5/16-18	16-24
Bolt	Stator control valve body to transmission case	5/16-18	8-11
Bolt	Valve body assembly to transmission case	5/16-18	8-11
Bolt	Solenoid valve to valve body	1/4 -20	8-12
Bolt	Vacuum modulator to transmission case	5/16-18	8-12
Bolt	Pump assembly to transmission case	5/16-18	16-24
Bolt	Rear bearing retainer to transmission case	3/8 -16	25-35
Bolt-Special	Oil Pan to transmission case	5/16-18	10-12
Bolt	Speedo sleeve retainer to bearing retainer	5/16-18	8-12
Bolt	Governor cover to transmission case	5/16-18	8-12

5-3 DESCRIPTION OF SUPER TURBINE "300" AUTOMATIC TRANSMISSION

The Super Turbine "300" automatic transmission is a combination torque converter, two speed planetary geared transmission. Torque multiplication is obtained hydraulically through the converter, and mechanically through a compound planetary gear set. The gear set, in combination with the torque converter, provides a high starting ratio for acceleration from a stop, up steep grades, etc. The torque converter provides torque multiplication for performance and exceptionally smooth operation. It functions as a fluid coupling at normal road load conditions and at higher speeds. Description of transmission is divided into six (6) basic sections: (1) Torque Converter, (2) Oil Pump, (3) Planetary Gear Set and Controls, (4) Reverse Clutch, (5) Governor, (6) Valve Body.

1. Torque Converter

The torque converter is connected to the engine flywheel and serves as a hydraulic coupling through which engine torque is transmitted to the input shaft. The torque converter steps up or multiplies engine torque whenever

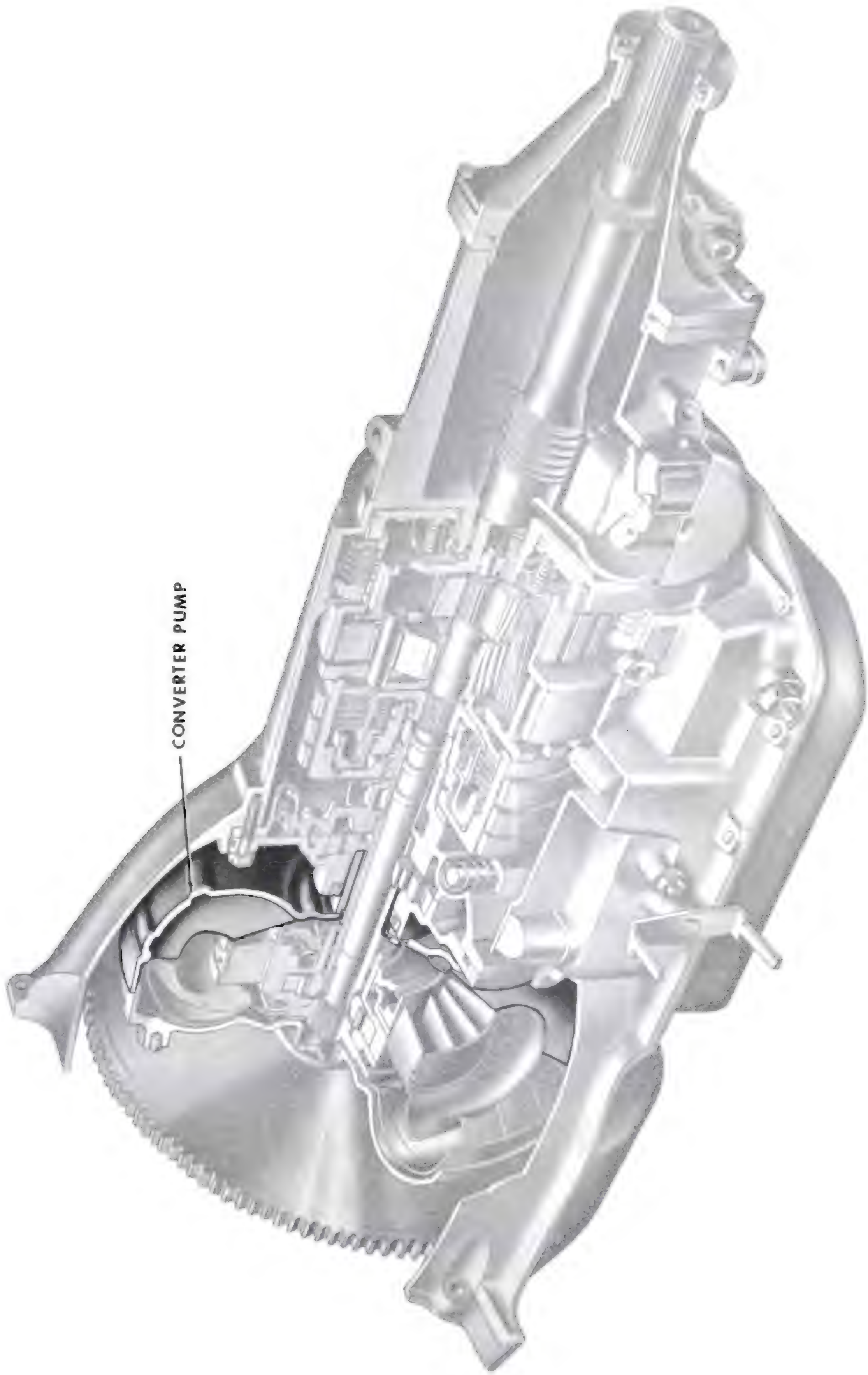


Figure 5-2—Converter Pump

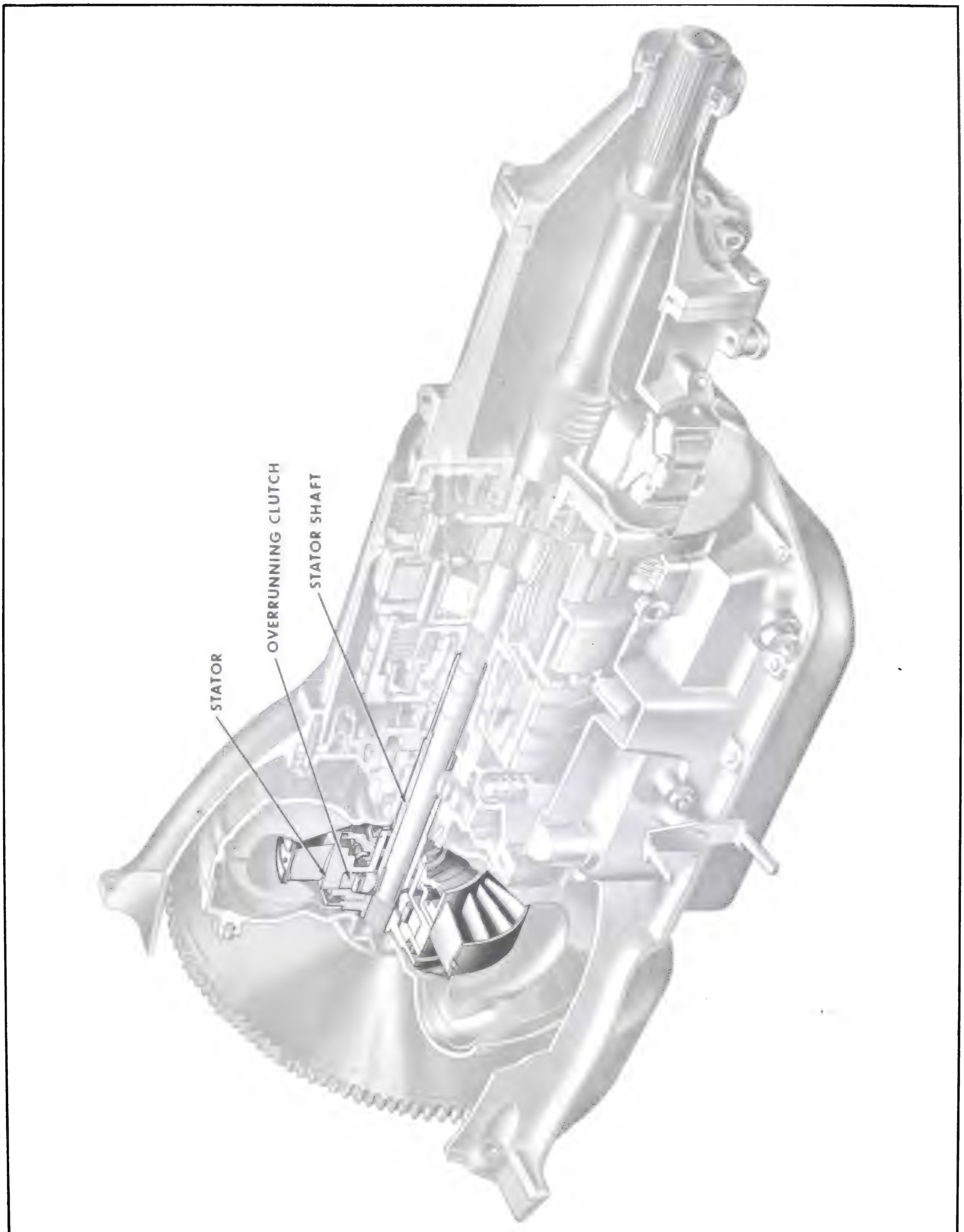


Figure 5-3—Stator and Stator Shaft

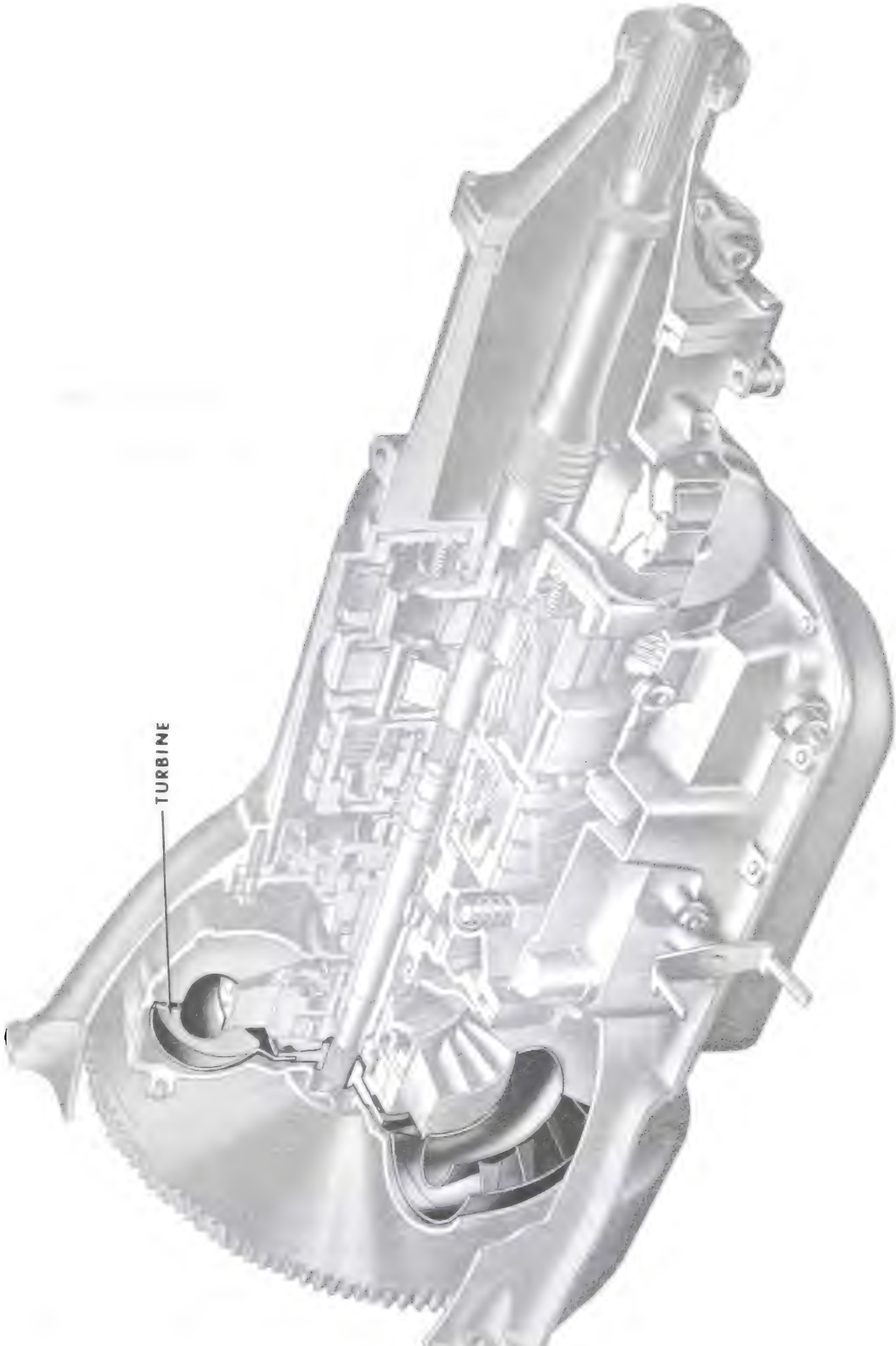


Figure 5-4—Converter Turbine

operating conditions demand greater torque than the engine alone can supply. The torque converter consists of three (3) basic sections: (a) Converter Pump, (b) Variable Pitch Stator, (c) Converter Turbine.

a. Converter Pump

The function of the converter pump is to convert engine torque into an energy transmitting flow of oil to drive the converter turbine into which the oil is projected. The converter pump operates as a centrifugal pump, picking up oil as its center and discharging the oil at its rim. However, the converter is shaped to discharge the oil parallel to its axis in the form of a spinning hollow cylinder. See Figure 5-2.

b. Variable Pitch Stator

The variable pitch stator is located between the converter turbine and the converter pump, and is supported by the stator shaft. The stator is equipped with a free wheel clutch assembly. When the clutch assembly is held stationary, it changes the direction of oil flow from the turbine to the proper angle for smooth entrance into the converter pump. As the turbine approaches pump speed the direction of oil flow changes until it no longer opposes pump rotation. The stator then free wheels so that it will not interfere with the flow of oil between the turbine and converter pump. For normal operation in Drive range the stator blades are set at low angle. For increased acceleration and performance, torque may be obtained by setting the stator blades at high angle. See Figure 5-3.

c. Converter Turbine

The function of the converter turbine is to absorb energy from the oil projected into it by the pump and convert the energy into torque and transmit that torque to the input shaft. See Figure 5-4.

2. Oil Pump

A positive displacement internal-external gear type oil pump is used to supply oil to fill the converter, for engagement of forward and reverse clutches for application and release of the low band and to accumulate oil for lubrication and heat transfer. See Figure 5-5.

3. Planetry Gear Set and Controls

The planetary gear set consists of an input sun gear, low sun gear, short and long pinions, a reverse ring gear and a planet carrier. The input sun gear is splined to the input shaft. The low sun gear, which is part of the forward clutch assembly, may revolve freely until the low band is applied. The input sun gear is in mesh with three (3) long pinions and the long pinions are in mesh with three (3) short pinions. The short pinions are in mesh with the low sun gear and reverse ring gear. The input sun gear and short pinions always rotate in the same direction. Application of either the low band or the reverse clutch determines whether the output shaft rotates forward or backward. See Figure 5-6.

a. Forward Clutch

The forward clutch assembly consists of a drum, piston, springs, piston seals, and a clutch pack. These parts are retained inside the drum by the low sun gear and flange assembly and retainer ring. When oil pressure is applied to the piston, the clutch plates are pressed together connecting the clutch drum to the input shaft through the clutch hub. This engagement of the clutch causes the low sun gear to rotate with the input shaft. See Figure 5-7.

b. Low Band

The low band is a double-wrap steel band faced with a bonded lining which surrounds the forward clutch drum. The band is hydraulically applied by the low servo piston, and released by spring pressure. See Figure 5-7.

4. Reverse Clutch

The reverse clutch assembly consists of a piston, inner and outer seal, cushion spring, coil springs, clutch pack, and pressure plate. These parts are retained inside the case by a retaining snap ring. When oil pressure is applied to the piston, the clutch plates are pressed together holding the reverse ring gear stationary. This engagement of the clutch causes reverse rotation of the output shaft. See Figure 5-8.

5. Governor

The governor is located to the rear of the transmission case on the left side and is driven off the output shaft. The purpose of the governor is to generate a speed sensitive modulating oil pressure that increases up to a point with output shaft or car speed.

6. Valve Body

The valve body assemblies are bolted to the bottom of the transmission case and are accessible for service by removing the oil pan. The main valve body assembly consists of manual control valve, stator and detent valve, shift valve, modulator limit valve, and high speed downshift timing valve. The stator valve body consists of a stator control valve.

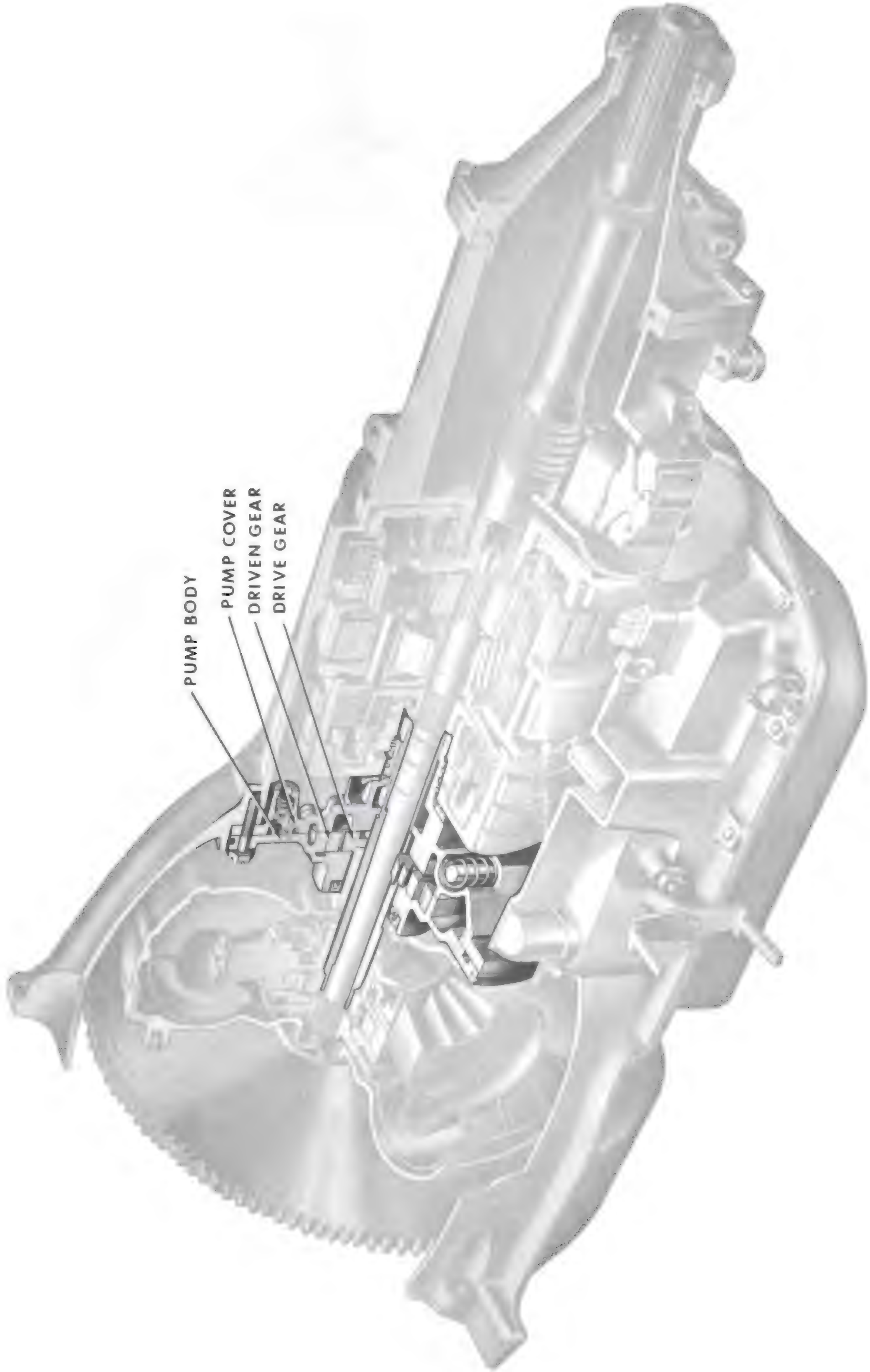


Figure 5-5—Oil Pump and Stator Shaft

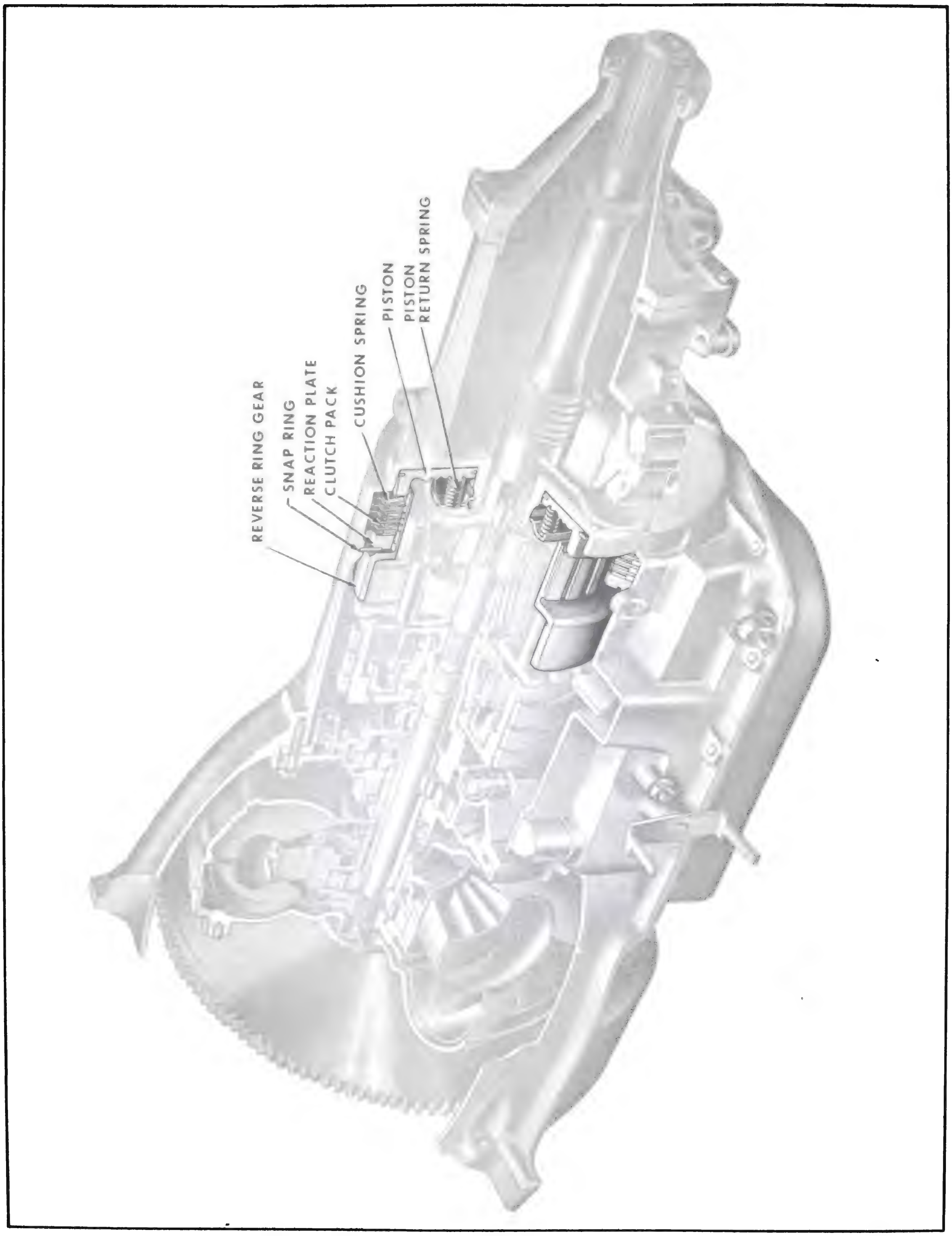


Figure 5-6—Reverse Clutch

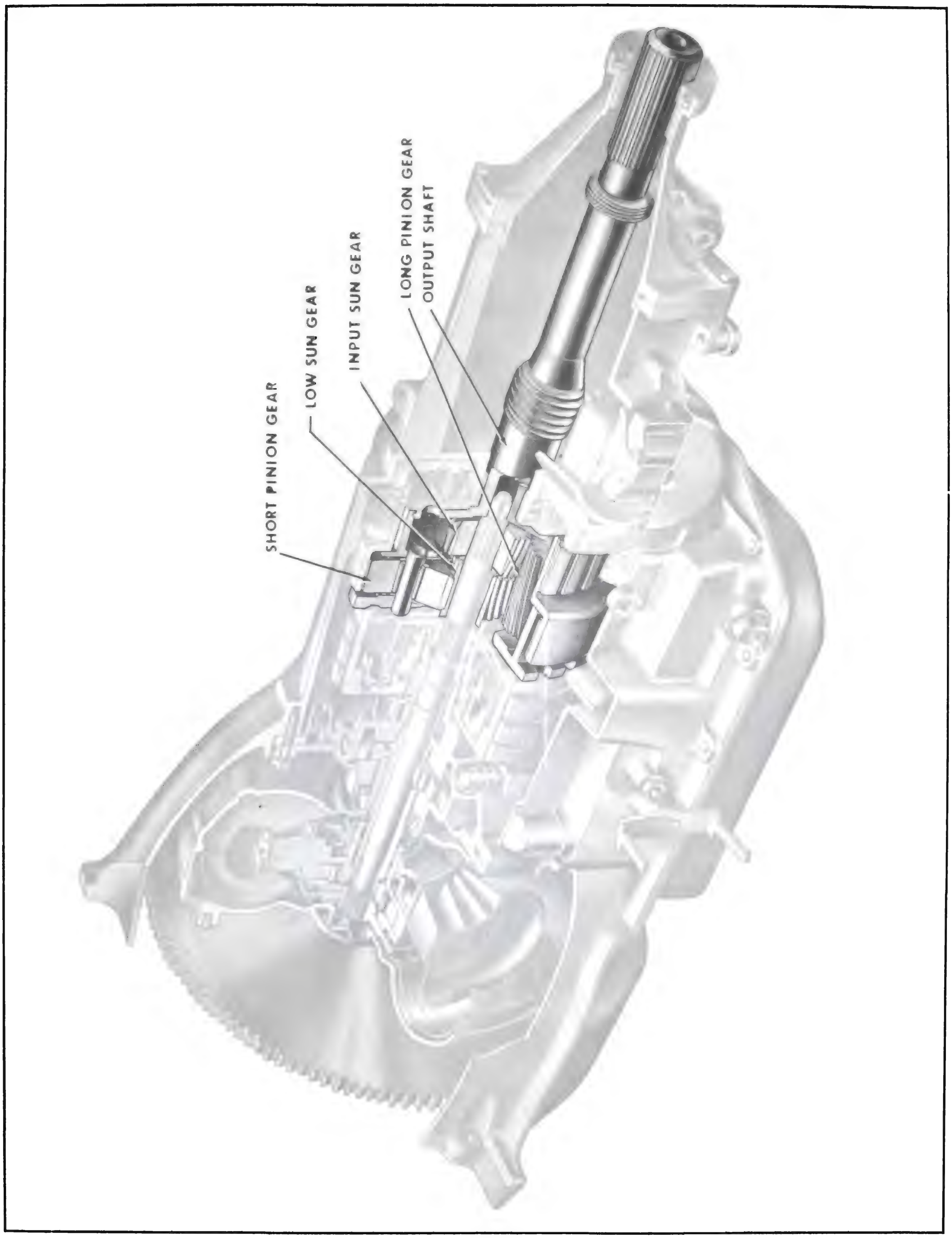


Figure 5-7—Planetary Gear Set

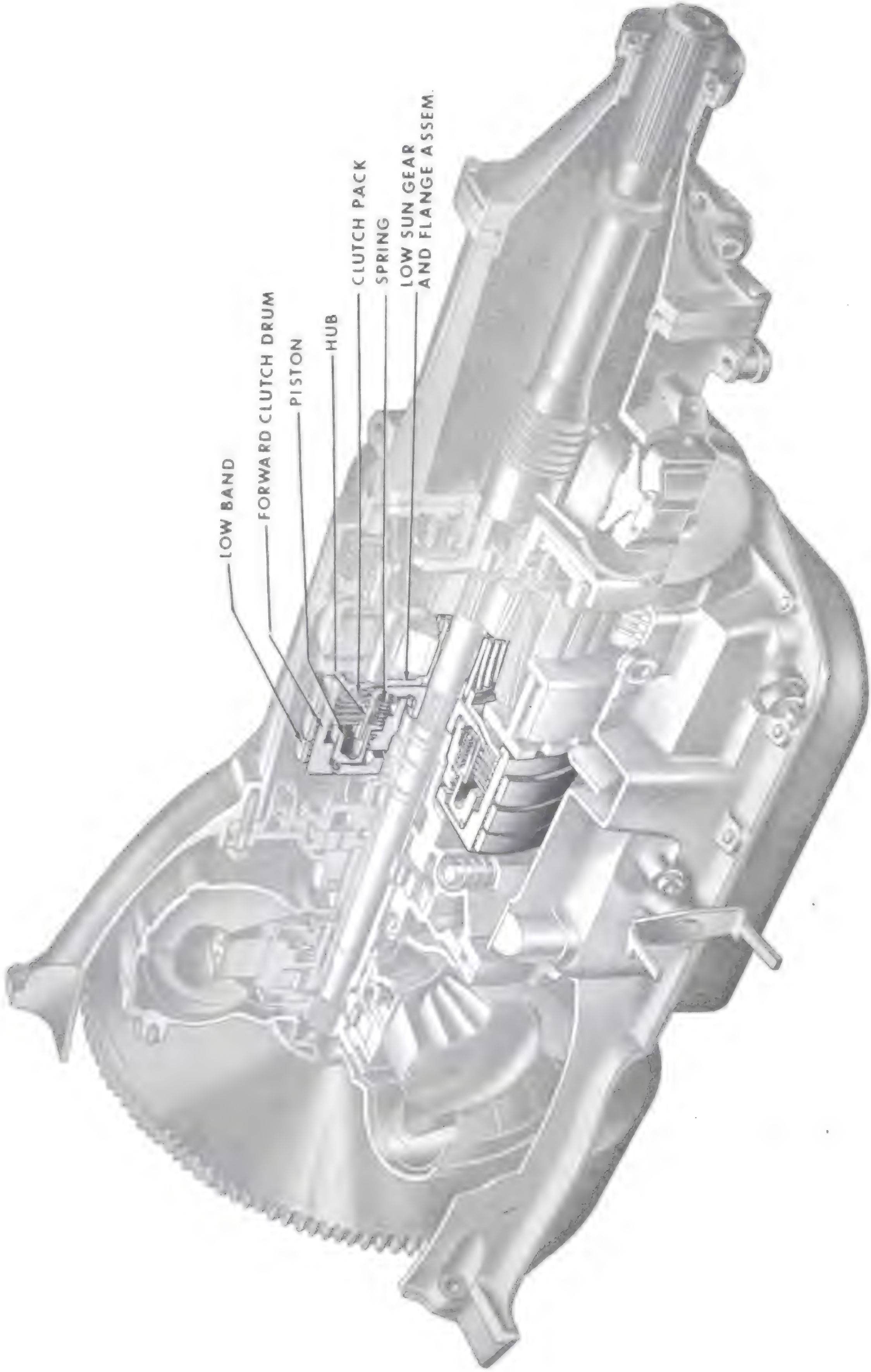


Figure 5-8—Forward Clutch and Low Band

Figure 5-9—Cross Section of Transmission

5-4 MECHANICAL OPERATION OF SUPER TURBINE "300" AUTOMATIC TRANSMISSION

1. Operation of Components in Drive Range

With the manual control lever in Drive range, the transmission is started automatically in Low range. The forward clutch is released and the low band is applied to the outside diameter of the forward clutch drum. With the low band applied, the low sun gear and flange assembly are held stationary. Drive then is from the converter through the input shaft to the input sun gear in the planetary gear set. The input sun gear drives the long planet pinions which in turn drive the short planet pinions. The short pinions are in mesh with the low sun gear. With the low sun gear held stationary by the low band application, the short pinions will walk around the low sun gear. As they walk around the sun gear, they carry with them the planet carrier and the output shaft to which they are attached, at a reduction of 1.76 to 1.

The upshift into Drive range is dependent upon car speed and throttle opening. When the shift occurs, the low band is released and the forward clutch is applied. Application of the forward clutch locks the planetary system causing it to rotate as a unit. With the clutch applied, the clutch hub which is splined to the input shaft is locked to the low sun gear and flange assembly through the clutch plates. The low sun gear is meshed to the short pinions, the short pinions are meshed with the long pinions, and the long pinions are meshed with the input sun gear; the sun gear is also splined to the input shaft. Since both the low sun gear and input sun gear are now locked to the input shaft, the entire planetary unit will revolve at input shaft speed. See Figure 5-10.

2. Operation of Components in Manual or Automatic Low Range

In Low range, the forward clutch is released and the low band is applied to the outside diameter of the forward clutch drum. With the low band applied, the low sun gear and flange assembly is held stationary. Drive then is from the converter through the input shaft to the input sun gear in the planetary gear set. The input sun gear drives the long planet pinions which are in mesh with the low sun gear. Since the low sun gear is held stationary with the low band applied, the short pinions walk around the low sun gear, and as they walk around the sun gear, they carry with them the planet carrier and the output shaft to which they are attached at a reduction of 1.76 to 1. See Figure 5-11.

3. Operation of Components in Reverse Range

When the manual control lever is in Reverse position, the forward clutch and low band are released, and the reverse clutch is applied, holding the ring gear stationary. Drive is through the input shaft and input sun gear to the long pinions and then to the short pinions. The short pinions mesh with the reverse ring gear which is held stationary by the reverse clutch. The short pinions walk around the inside of the ring gear in a reverse direction, turning the output shaft to which they are attached at a reduction of 1.76 to 1. See Figure 5-12.

4. Operation of Components in Neutral

With the shift control lever in Neutral position, the output shaft remains stationary. The clutches and low band are released; therefore, there is no reaction member to provide positive drive. All gears are free to spin around their own axis, and no motion is imparted to the planet carrier. See Figure 5-13.

5. Operation of Components in Park

In Park, all reaction members are released as in Neutral. A positive gear train lock is provided when the parking pawl is engaged with the heavy teeth spaced around the front face of the planetary carrier. The linkage is actuated by direct manual action, but the parking pawl is activated by spring action. If the pawl is in line with a tooth of the planet carrier, rather than a space between teeth, the linkage remains in the park position with the spring holding pressure against the pawl. Slight rotation of the planet carrier will immediately seat the pawl and lock the output shaft to the case. See Figure 5-13.

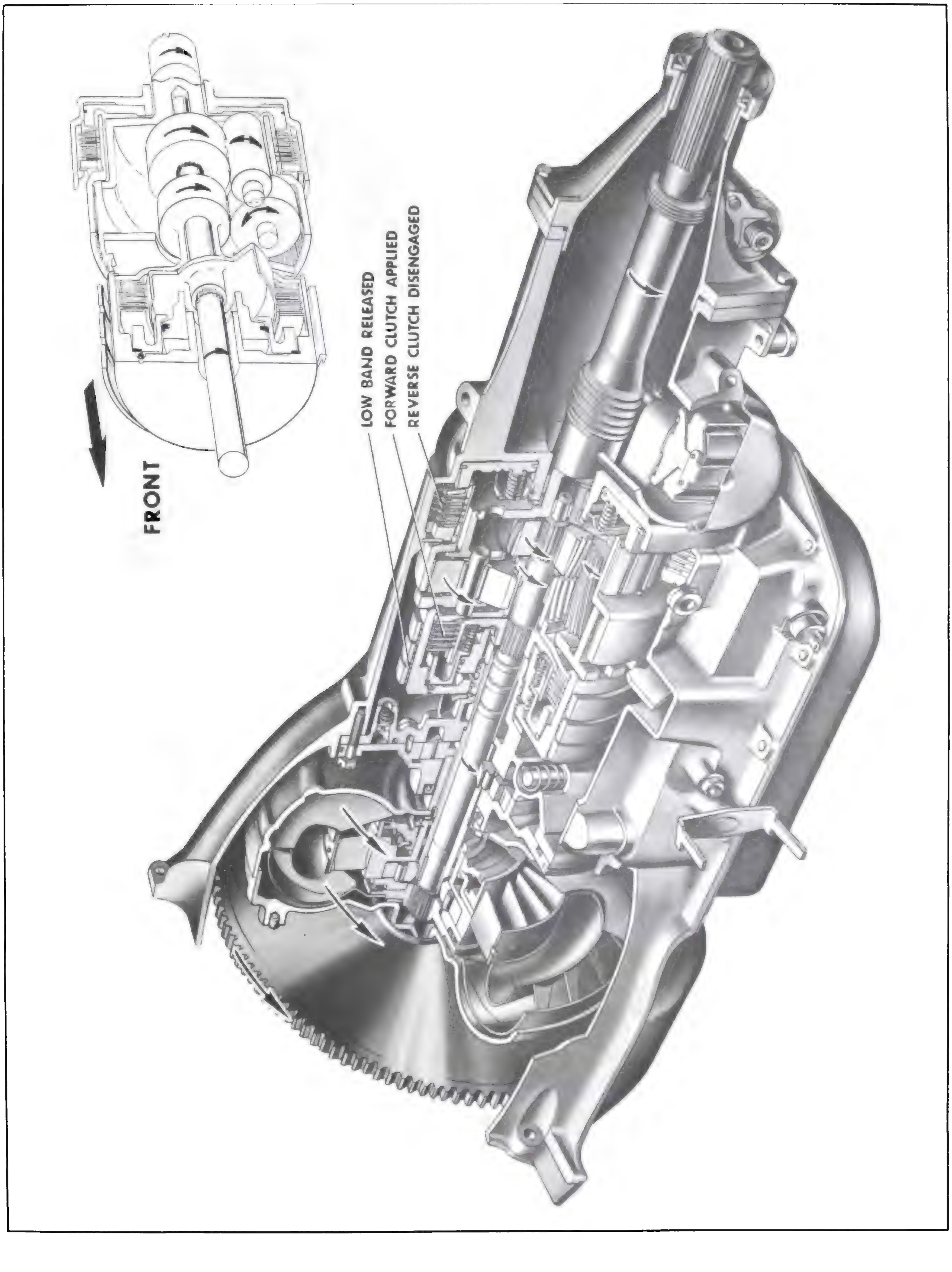


Figure 5-10—Operation of Components in Drive Range

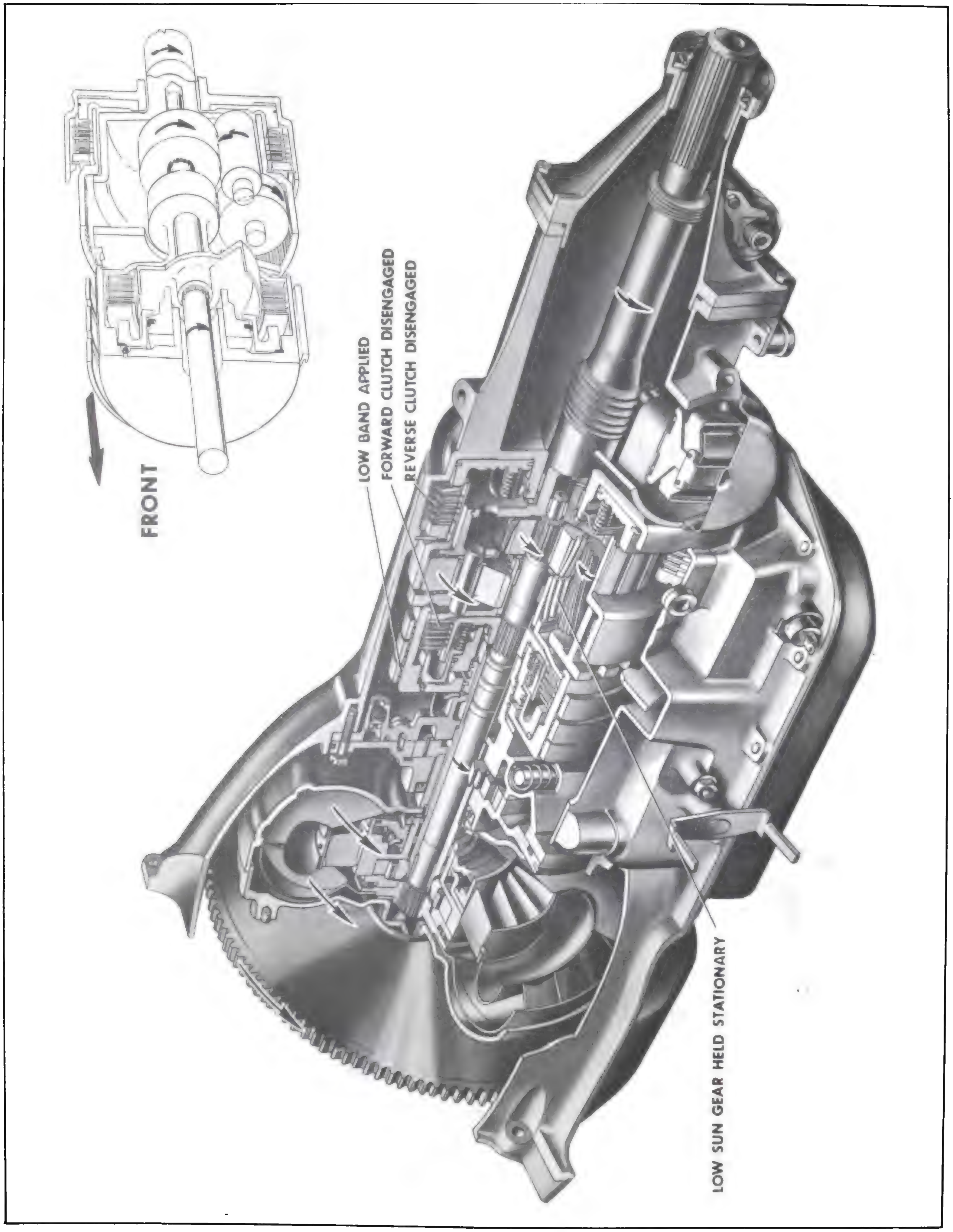


Figure 5-11—Operation of Components in Manual Low or Automatic Low

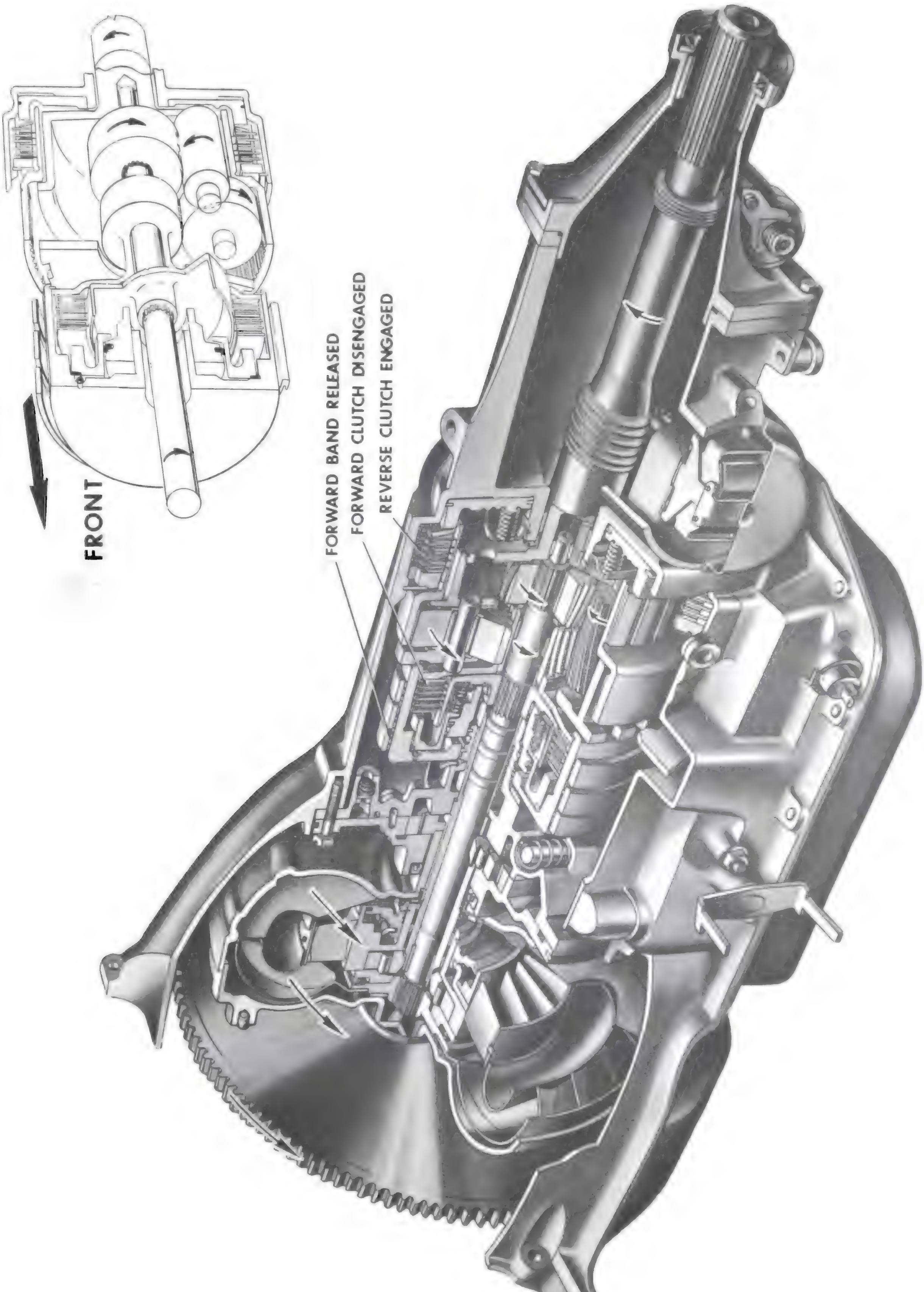


Figure 5-12—Operation of Components in Reverse Range

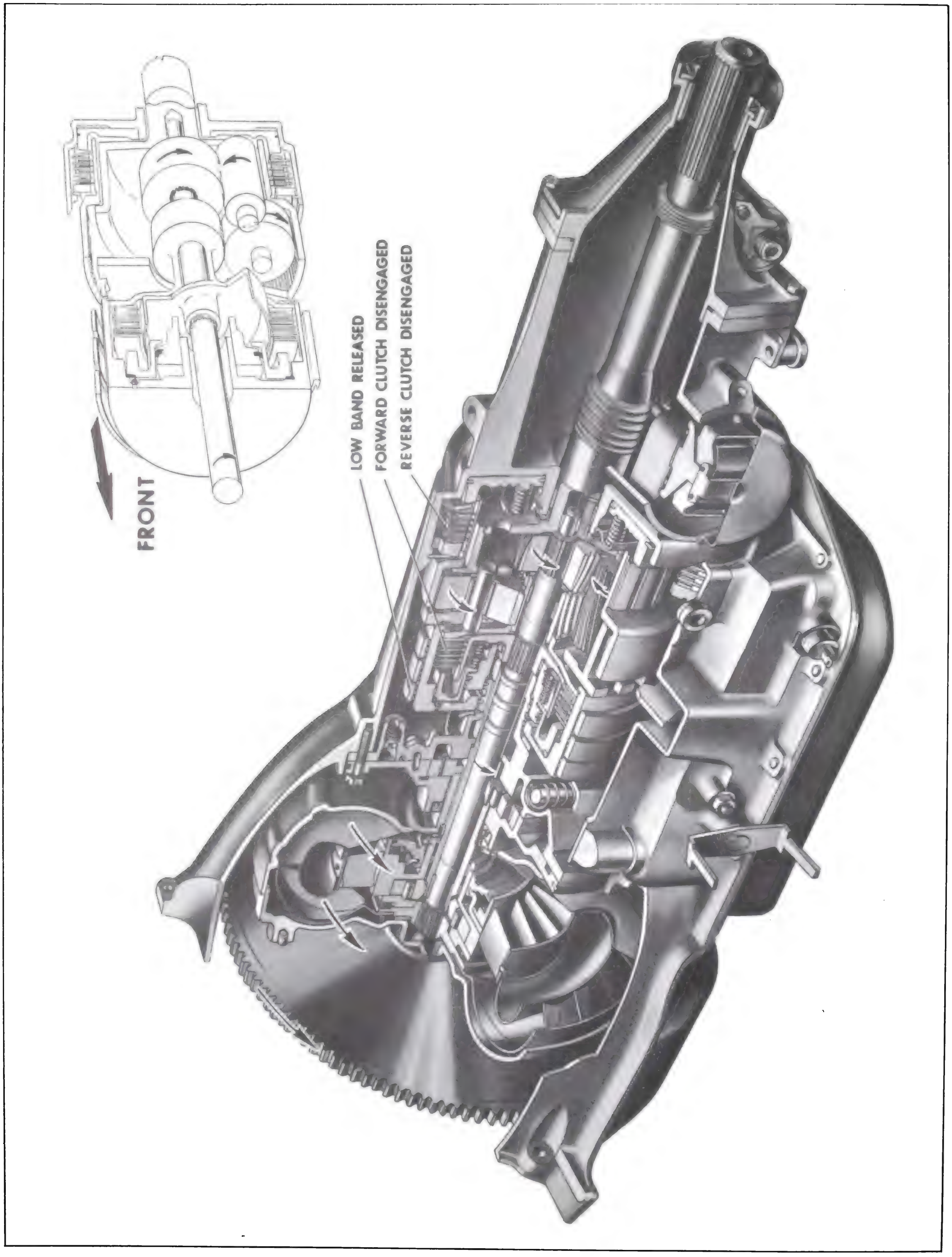


Figure 5-13—Operation of Components in Neutral and Park Range

SECTION 5-B
HYDRAULIC CONTROLS

CONTENTS OF SECTION 5-B

5-5 OIL PUMP AND PRESSURE REGULATOR

a. Oil Pump

A positive displacement internal-external gear type oil pump is used to supply oil to fill the converter, for engagement of the forward and reverse clutches for application and release of the low band and to accumulate oil for lubrication and heat transfer.

b. Main Pressure Regulator Valve

The pressure regulator valve located in the pump cover is used as the basic control of hydraulic pressure within the transmission.

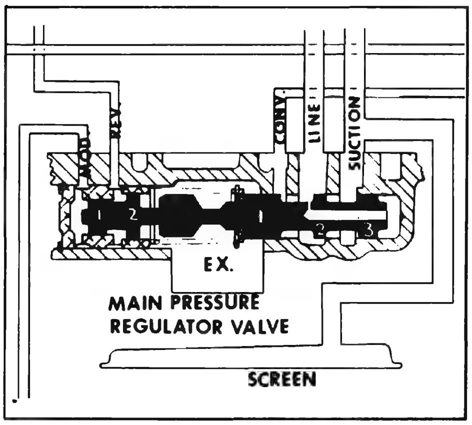


Figure 5-14—Pressure Regulator Valve (First Stage Regulation)

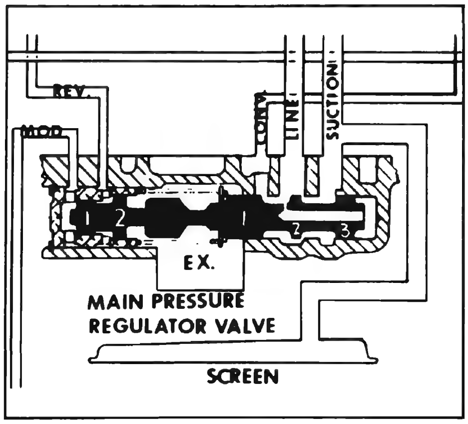


Figure 5-15—Pressure Regulator Valve (Second Stage Regulation)

1. First Stage Regulation

When the engine is idling or has just been started, oil enters the main pressure regulator valve assembly between the first and second lands and flows through interconnecting drilled holes in the valve to occupy the space between the third land and the oil pump cover. Oil under pressure between the third land and the pump cover moves the valve against its spring to uncover the port which directs oil to the converter and thence to the oil cooler and lubrication systems of the transmission. Figure 5-14 shows the pressure regulator valve in first stage regulator position.

2. Second Stage Regulation

As higher engine speeds are attained, the volume of oil leaving the pump increases until the valve moves to the position shown in Figure 5-15 which opens a port to allow main line oil to escape to suction to regulate pressure. Second stage regulation is only necessary during operation at high speeds or operation with cold oil.

3. Boost Valve

A boost valve at the spring end of the pressure regulator valve functions to raise line pressure when necessary by adding hydraulic pressure to the spring pressure on the main pressure regulator valve.

4. Modulator Boost

With the manual shift control valve positioned in drive range, oil under pressure varied by operating conditions (load, car speed, grade, etc.) is directed to the space between the first land of the boost valve and the valve body. Oil under pressure in this space has the same effect as increasing the spring pressure against the pressure regulator valve, that is, it increases main line oil pressure.

5. Reverse Boost

With the manual shift control valve positioned in reverse range, oil under pressure is directed to the space between the first and second lands of the boost valve. Since the second land is larger than the first, the boost valve bears on the spring end of the pressure regulator valve adding to the spring pressure of the valve, thus increasing mainline oil pressure for operation in reverse range.

5-6 HYDRAULIC CONTROLS

The hydraulic control system consists of the following main components:

- Manual Shift Control Valve
- Stator Control Valve
- Shift Valve and Shift Control Valve
- Vacuum Modulator Valve
- Governor Valve
- Modulator Limit Valve
- Detent Valve
- High Speed Downshift Timing Valve
- Coast Downshift Timing Valve

a. Manual Shift Control Valve

The manual shift control valve in the valve body routes oil to the controlling devices that govern operation in Drive, Low and Reverse. In Neutral and Park ranges, the manual control valve cuts off oil pressure to the low servo and forward clutch. See Figure 5-16. The manual shift control valve is connected by mechanical linkage to the manual control lever on the steering column.

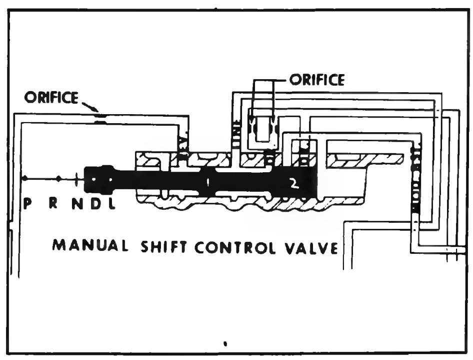


Figure 5-16—Manual Shift Control Valve

b. Stator Control Valve

The stator control valve is a spring loaded valve located in the stator control valve body. The

function of this valve is to control high or low angle of the stator blades. See Figures 5-17-5-18. The action of the valve is affected by spring pressure and a solenoid valve. When the stator control valve solenoid is energized the valve plunger is retracted, uncovering an exhaust port through which oil may escape from the spring side of the stator control valve. Oil thus escaping allows oil at converter charging pressure to move the valve against its spring. With the stator valve positioned against the valve plug no oil is directed to the front of the stator blade piston and converter charging pressure then moves the piston (connected to the stator blade cranks) to shift the blades to high angle. See Figure 5-17.

c. Shift Valve and Shift Control Valve

The shift valve and shift control valve are housed together in the main valve body. They interpret oil pressure from the governor

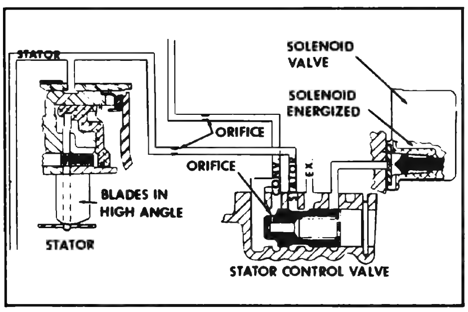


Figure 5-17—Stator Blades in High Angle

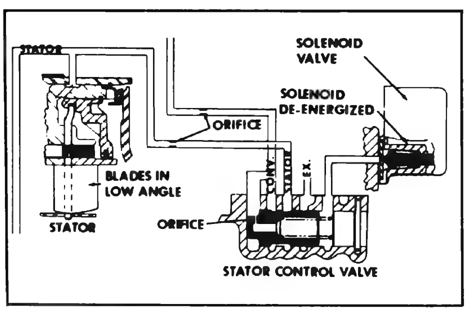


Figure 5-18—Low Angle

and vacuum modulator valve to the shift from automatic low (manual shift control valve in drive range) to drive range or from drive to automatic low range.

1. Upshift from automatic low range to drive range

As the car is accelerated from a stop the shift valve and shift regulator valve are positioned as shown in Figure 5-20. The shift valve is held against the end of its bore by the force of a spring and the pressure exerted on the second and third lands of the shift regulator valve. With the shift valve thus positioned no oil under pressure is directed to the high clutch piston or spring side of the low servo piston, thus the low band is applied and the transmission is in low range.

When the proper relationship between car speed and throttle opening exists, governor oil pressure against the first land of the shift valve will overcome its spring pressure and the force of limited modulator oil pressure against the shift regulator valve and move both valves to the right as shown in Figure 5-21.

With the valves thus positioned, oil under pressure is directed to the forward clutch piston and the spring side of the low servo piston.

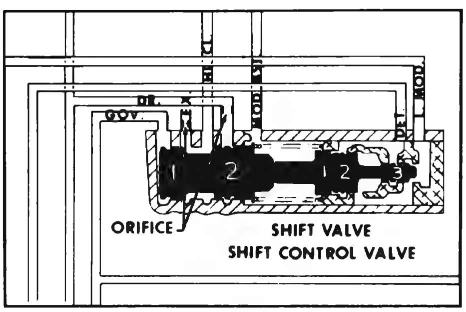


Figure 5-20—Automatic Low

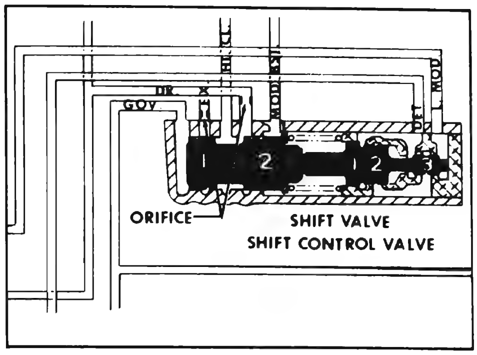


Figure 5-21—Up-Shifted

With the shift regulator valve positioned to the right as shown in Figure 5-21, limited modulator pressure is bearing only on the third land of the valve. With limited modulator oil pressure bearing only on the third land of the shift regulator valve, a greater throttle opening (providing greater limited modulator pressure) is necessary to cause a downshift than was required to allow an upshift at a given car speed.

2. Downshift from drive to manual low

When limited modulator pressure against the third land of the shift regulator valve in combination with the shift valve spring reaches a value sufficient to overcome governor valve pressure against the first land of the shift valve, both valves move to the shift valve end of the bore and the transmission is downshifted by exhausting oil under pressure to the high clutch and spring side of the low servo piston. See Figure 5-22.

3. Manual Low

With the manual shift control valve positioned in low (L) range oil under pressure is directed to the space between the shift valve and the shift regulator valve. Oil under pressure in this space adds

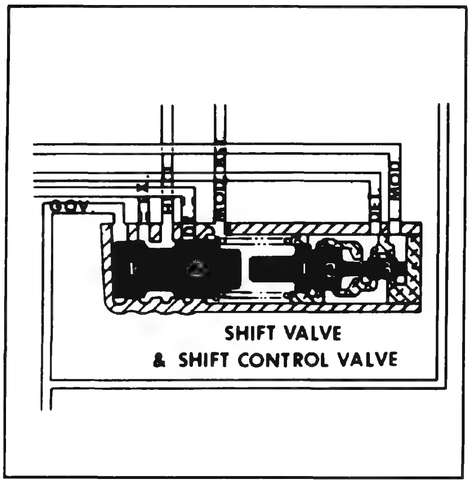


Figure 5-22—Manual Low

to the shift valve spring pressure and moves the shift valve to the end of its bore. With the shift valve thus positioned no oil under pressure is directed to the high clutch piston or spring side of the low servo piston, thus the low band is applied and the transmission is in low range. See Figure 5-22.

d. Vacuum Modulator and Valve

The vacuum modulator and valve assembly is a device to translate load (engine manifold vacuum), barometric pressure (altitude) and speed (governor valve oil pressure) into modulated oil pressures to regulate main line oil pressure at an efficient value.

Main line oil enters the valve between the first and second lands of the valve, flows through the drilled ports to the space between the first land and the valve body. Here, the oil when it reaches sufficient pressure moves the valve against its spring to regulate the exit oil (called modulator oil).

1. Manifold vacuum effect

The modulator valve spring is housed in a sealed container in such a way that engine manifold vacuum may act upon it to reduce the force of the spring against the valve and thus affect modulator oil pressure. Conditions of load or grade that lower manifold vacuum increase modulator oil pressure, while high manifold vacuum decreases modulator pressure. See Figure 5-23.

2. Altitude or barometric pressure effect

If the car is operated at high altitudes where barometric pressure is reduced the aneroid device in the vacuum modulator housing expands and acts against the valve spring to reduce modulator oil pressure in proportion to the barometric pressure.

At high altitudes engine output is reduced. Comparable reduction in transmission main line oil pressure is necessary to accomplish smooth shifts under these conditions.

3. Governor effect

As car speed increases governor valve oil pressure increases (up to the limit of the valve as described in subpar. e below).

Oil at governor valve pressure bearing on the fourth land of the vacuum modulator valve has the effect of reducing the spring pressure against the valve, thereby reducing modulator oil pressure as governor pressure (car speed) increases.

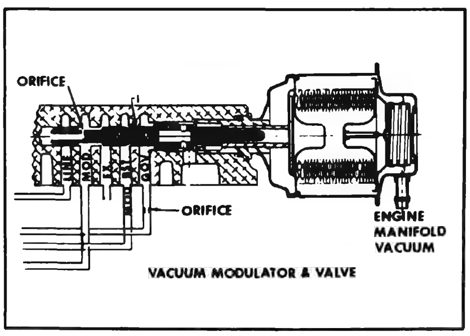


Figure 5-23—Vacuum Modulator and Valve

4. Modulator boost effect

With the manual shift control valve positioned in Low (L) range, oil at main line pressure bears against the second land of the modulator valve which separates the two pieces of the valve and tends to move the valve to the bottom of its bore independent of the valve spring. Thus, modulator oil under pressure is directed to the main line pressure regulator valve to provide an increase in main line oil pressure in low range, regardless of engine vacuum. If driving conditions result in low engine vacuum however, the valve spring will move the two sections of the valve back together. Then both the valve spring and the pressure of main line oil against the second land of the valve will regulate modulator oil pressure.

e. Governor Valve

The governor valve is a pressure regulator valve the output of which is determined by car speed acting through the centrifugal force of a pair of dual weights; the inner pair of which is spring loaded. See Figure 5-24.

As the car begins to move the weight assemblies move outward to provide a regulating force against the valve through the springs between the primary and secondary weights. As car speed is further increased, regulating force against the valve is provided by the secondary weights moving outward. At approximately 35 MPH the primary weights have reached the limit of their travel and the force against the valve is then entirely through the secondary weights.

Thus governor valve pressure is determined at very low speeds by the primary weights at intermediate speeds by the springs

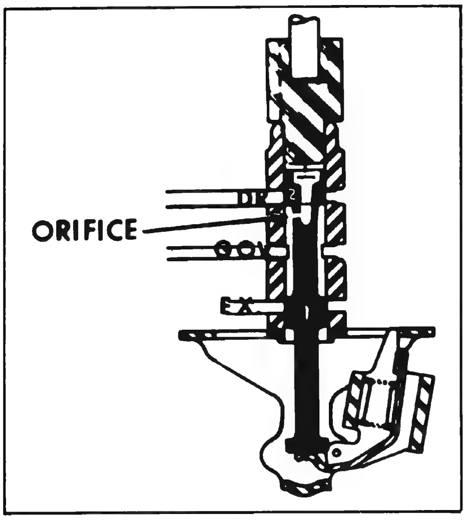


Figure 5-24—Governor Valve

between the weights and at higher speeds by the secondary weights. In this manner governor pressure is increased rapidly but smoothly from very low speeds to approximately 40 MPH, where it increases at a slower rate.

Regulated oil from the governor valve is channeled to the shift valve, vacuum modulator valve, modulator limit valve, and high speed down shift timing valve.

Governor pressure thus determines or affects shift points, main line oil pressure, and down shift timing.

f. Modulator Limit Valve

The modulator limit valve is a pressure regulator valve that regulates the point at which a wide open throttle up shift will occur.

The valve regulates limited feed oil (main line pressure) to provide diminishing oil pressure bearing against the second and third lands of the shift control valve as car speed is increased. This decrease in oil pressure is accomplished by governor valve pressure bearing on the third land of the valve and acting to diminish spring pressure as car speed (governor valve pressure) in-

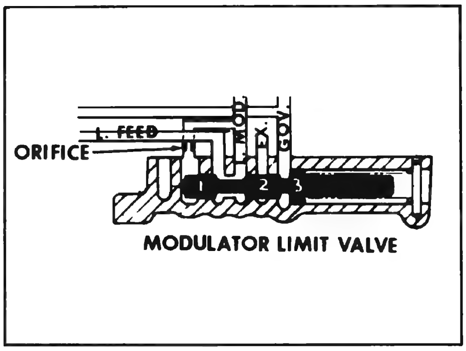


Figure 5-25—Modulator Limit Valve (First Stage)

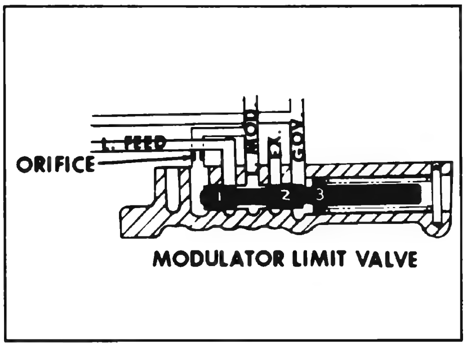


Figure 5-26—Modulator Limit Valve (Second Stage)

creases. See Figures 5-25 and 5-26.

The modulator limit valve is in operation only before the upshift during wide open throttle operation with the manual shift control valve in Drive position.

g. Detent Valve

The detent valve is a solenoid operated two position valve that provides a downshift at wide open throttle if car speed is low enough.

Electrical contacts on the carburetor linkage energize the detent solenoid as wide open throttle is reached. Energization of the solenoid retracts its plunger and allows oil from the center of the valve to flow to exhaust. Main line oil pressure against the first land and end of the valve moves the valve against its spring as shown in Figure 5-27.

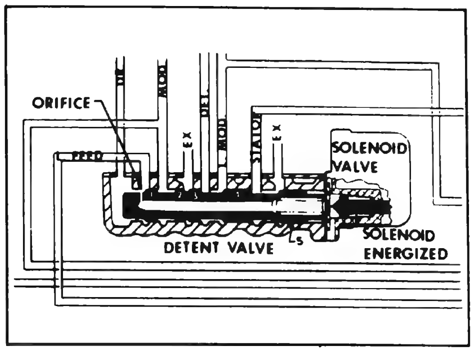


Figure 5-27—Solenoid Valve Energized

With the valve in this position, ports are opened to allow oil at main line pressure flow to the modulator limit valve and limited modulator oil to flow to the detent port of the shift control valve. When the solenoid is de-energized the spring loaded plunger seals the port in the valve center. Oil at main line pressure then occupies the center of the valve and bears against the fifth land of the valve as well as the first land. The detent valve spring then moves the valve to the position shown in Figure 5-28, shutting off the modulator, detent and limited modulator ports.

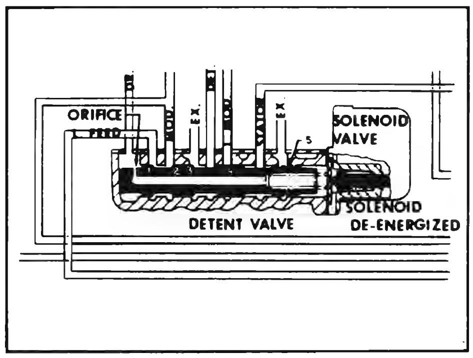


Figure 5-28—Solenoid Valve De-Energized

h. High Speed Down Shift Timing Valve

The high speed downshift timing valve is a spring loaded valve located in the main valve body. Its function is to control the rate of low servo application at high road speeds.

At sufficiently high road speeds governor pressure against the first land of the valve overcomes spring pressure to move the valve to the position shown in Figure 5-29. With the valve in this position oil for low servo application must pass two orifices as shown. At lower car speeds, governor valve pressure is not sufficient to overcome the spring pressure and low servo application is made through passages containing one orifice as shown in Figure 5-30.

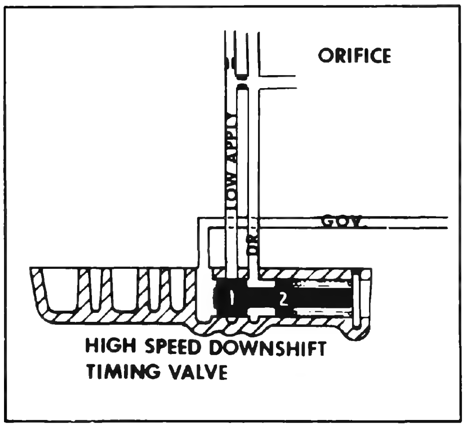


Figure 5-29—High Speed Downshift Timing Valve

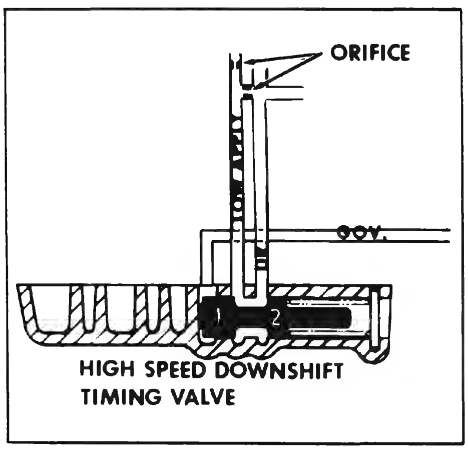


Figure 5-30—High Speed Downshift Timing Valve Regulated

i. Coast Down Shift Timing Valve

As the car is decelerating with closed throttle or very light throttle (such as when approaching a stop) governor valve pressure diminishes to a point where spring pressure moves the shift valve to the down shift position. When this occurs, oil is exhausted from the band release chamber of the low servo through the coast downshift timing valve.

A rush of oil through the valve moves the ball retainer and ball against light spring pressure off its seat, oil may then escape around the ball retainer and spring. This action cushions the initial engagement of the low band. See Figure 5-31.

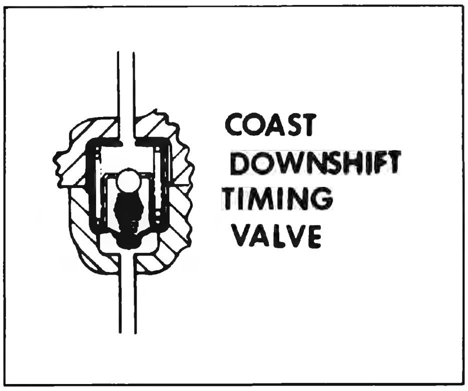


Figure 5-31—Coast Downshift Timing Valve

i. Operation of Hydraulic Controls in Drive Range (Part Throttle Upshifted)

During operation in Drive range the manual shift control valve is positioned as shown in Figure 5-32. During part throttle acceleration main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is routed into the drive oil passage and then directed to the governor valve, shift valve, detent valve, high speed downshift timing valve and low servo.

Main line oil being directed to the modulator valve enters between the first and second lands. At low engine vacuum the vacuum modulator tends to keep the valve toward the bottom of its bore. In this position oil is delivered through a drilled passage in the valve to the space between the first land of the valve and the valve body. Oil under pressure in this area plus governor pressure on the second land of the second modulator valve tends to move the valve against the force of its spring to regulate modulator oil pressure leaving the valve. Modulator oil leaves the modulator valve and is routed to the boost valve, detent valve, modulator limit valve, and to the area between the second land of the shift control valve and the valve body. Modulator pressure applies a force to the space between the first land of the boost valve and the oil pump body causing it to move to the right in Figure 5-32. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in higher main line pressure. Also modulator pressure is routed through the detent valve and modulator limit valve to apply force in the space between the third land of the shift regulator and the valve body.

When sufficient car speed has been obtained, the governor valve will move allowing drive oil to be directed at regulated pressure to the space between the first land of the shift valve and the valve body and between second and third lands of the modulator valve, between the second and third lands of the modulator limit valve and in the space between the first land of the high speed down shift timing valve and the valve body. As governor pressure is received between the second and third lands of the modulator valve it will tend to move the valve against

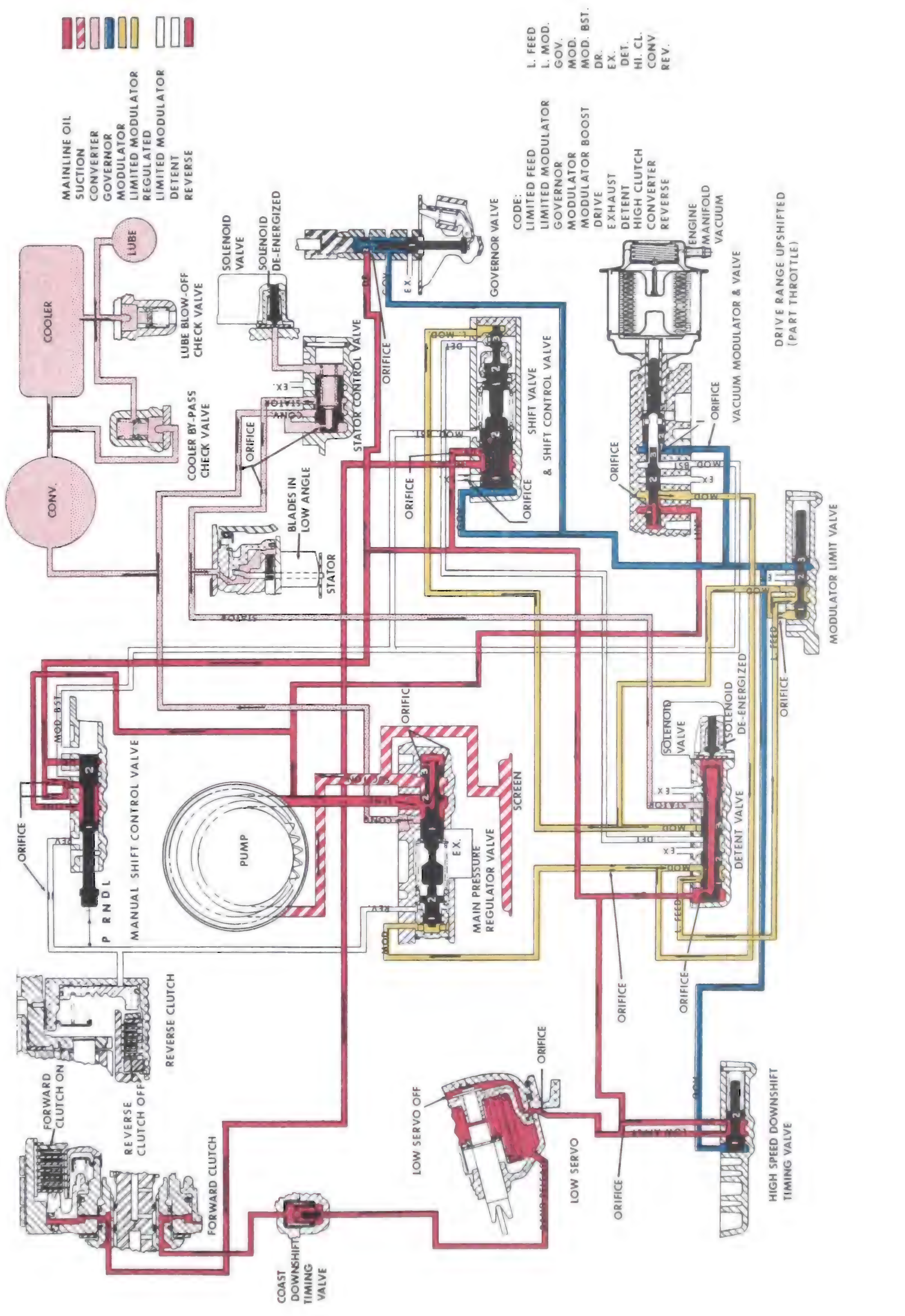


Figure 5-32—Drive Range Upshifted (Part Throttle)

its spring, reducing modulator pressure.

When governor pressure reaches a high enough value the shift valve will move to the right allowing drive oil to apply the forward clutch and release the low band.

k. Operation of Hydraulic Controls in Drive Range (Full Throttle to Detent Switch Pitch Only)

During operation in Drive range at full throttle to detent switch pitch only, the stator control solenoid is energized. See Figure 5-33.

Main line oil passes through the pressure regulator valve to the converter and stator control valve. Energization of the stator control solenoid allows oil from the center of the valve to flow to exhaust. Converter oil pressure against the valve body and the first land of the valve moves the valve against its spring until it bottoms in its bore. When the valve reaches the bottom of its bore it will exhaust the stator, switching the blades to high angle.

Main line oil entering the manual shift control valve is routed into the drive oil passage and then directed to the governor valve, shift valve, detent valve, high speed down shift timing valve and low servo. Main line oil directed to the modulator valve enters between the first and second lands. At low engine vacuum, the vacuum modulator tends to keep the valve toward the bottom of its bore. In this position, oil is delivered through a drilled passage in the valve to the space between the first land of the valve and the valve body. Oil pressure in this area plus governor pressure on the second land of the second modulator valve will tend to move the valve against the force of its spring to regulate modulator oil pressure leaving the valve. At the same time, line oil pressure enters the area between the first and second lands of the modulator valve and into the modulator pressure line. Modulator oil leaves the modulator valve and is routed to the boost valve, detent valve, modulator limit valve, and to the area between the second land of the shift control valve and the valve body. Modulator pressure applies a force to the space between the first land of the boost valve and the oil pump body causing it to move to the right in Figure 5-33. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in a higher main line pressure. Also limited modulator pressure is routed through the detent valve and to the modulator limit valve. Limited modulator from the modulator limit valve is routed to the rear face of the shift control valve.

When sufficient speed is obtained, the governor valve will move, allowing drive oil to be directed at reduced pressure to left end of the shift valve and between the second and third lands of the modulator valve, between the second and third lands of the modulator limit valve and at the left end of the high speed down shift timing valve. As governor pressure is received between the second and third lands of the modulator valve it will tend to move the valve to the right, reducing modulator pressure. When governor pressure reaches a high enough value, the shift valve will move to the right allowing drive oil to apply the forward clutch.

l. Operation of Hydraulic Controls in Drive Range (Full Throttle Detent and Switch Pitch)

During operation in Drive range at full throttle detent and switch pitch, both the stator control valve and detent valve solenoids are energized. The manual shift control valve is positioned as shown in Figure 5-34.

Main line oil passes through the pressure regulator valve to the converter and stator and detent valve. When the stator control valve solenoid is energized it allows oil from the center of the valve to flow to exhaust. Converter oil applying force to the area between the valve body and the first land of the valve moves the valve against its spring pressure to the bottom of its bore.

When the valve reaches the bottom of its bore it will exhaust the stator, switching the pitch to high angle. Converter pressure oil applies force to the area between the valve body and the first land of the valve keeping it at the bottom of its bore as long as the solenoid is energized.

Energization of the detent solenoid allows oil from the center of the valve to flow to exhaust. Drive oil applying force to the area between the valve body and the first land of the valve moves the valve against its spring pressure to the bottom of its bore.

During a full-throttle acceleration main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is routed into the drive oil passage and then directed to the governor valve, shift valve, detent valve, high speed down shift timing valve, and modulator limit valve, and low servo.

Main line oil directed to the modulator valve enters between the first and second lands. At low engine vacuum the vacuum modulator tends to keep the valve toward the bottom of its bore. In this position oil is delivered through a drilled passage in the valve to the space between the first land of the valve and the

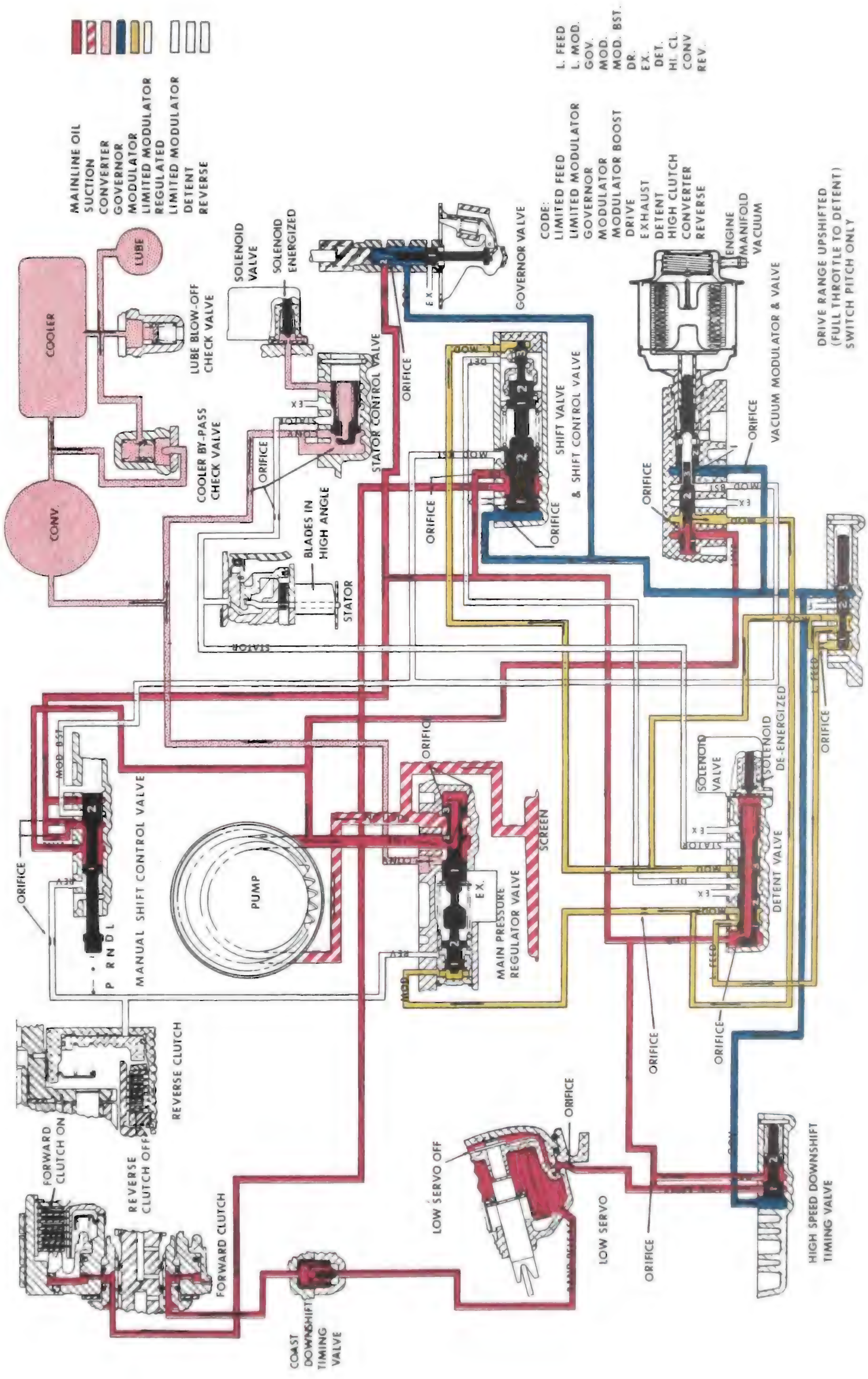


Figure 5-33—Drive Range (Full Throttle to Detent Switch Pitch Only)

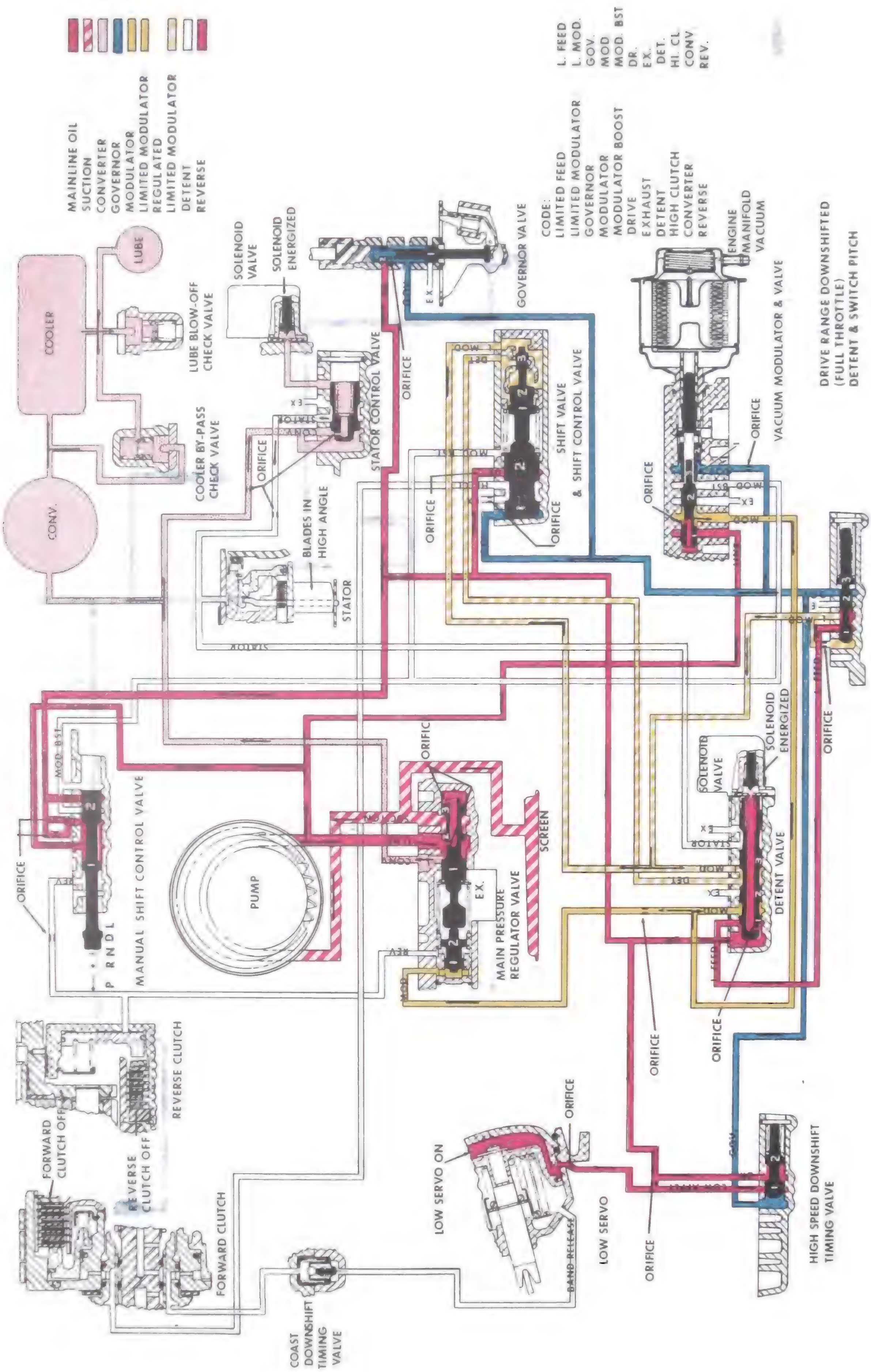


Figure 5-34—Drive Range (Full Throttle to Detent and Switch Pitch)

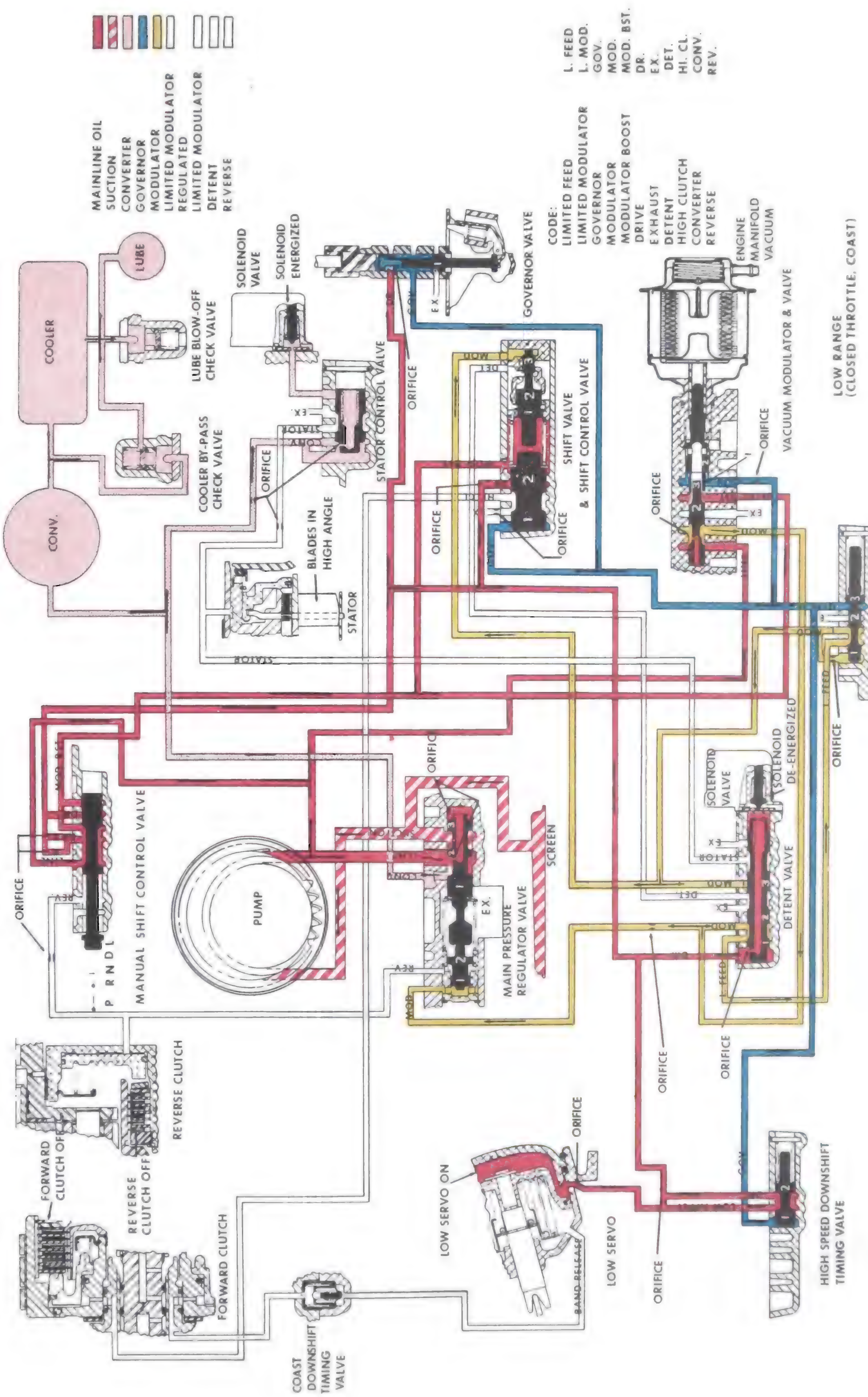


Figure 5-35—Low Range (Closed Throttle Coast)

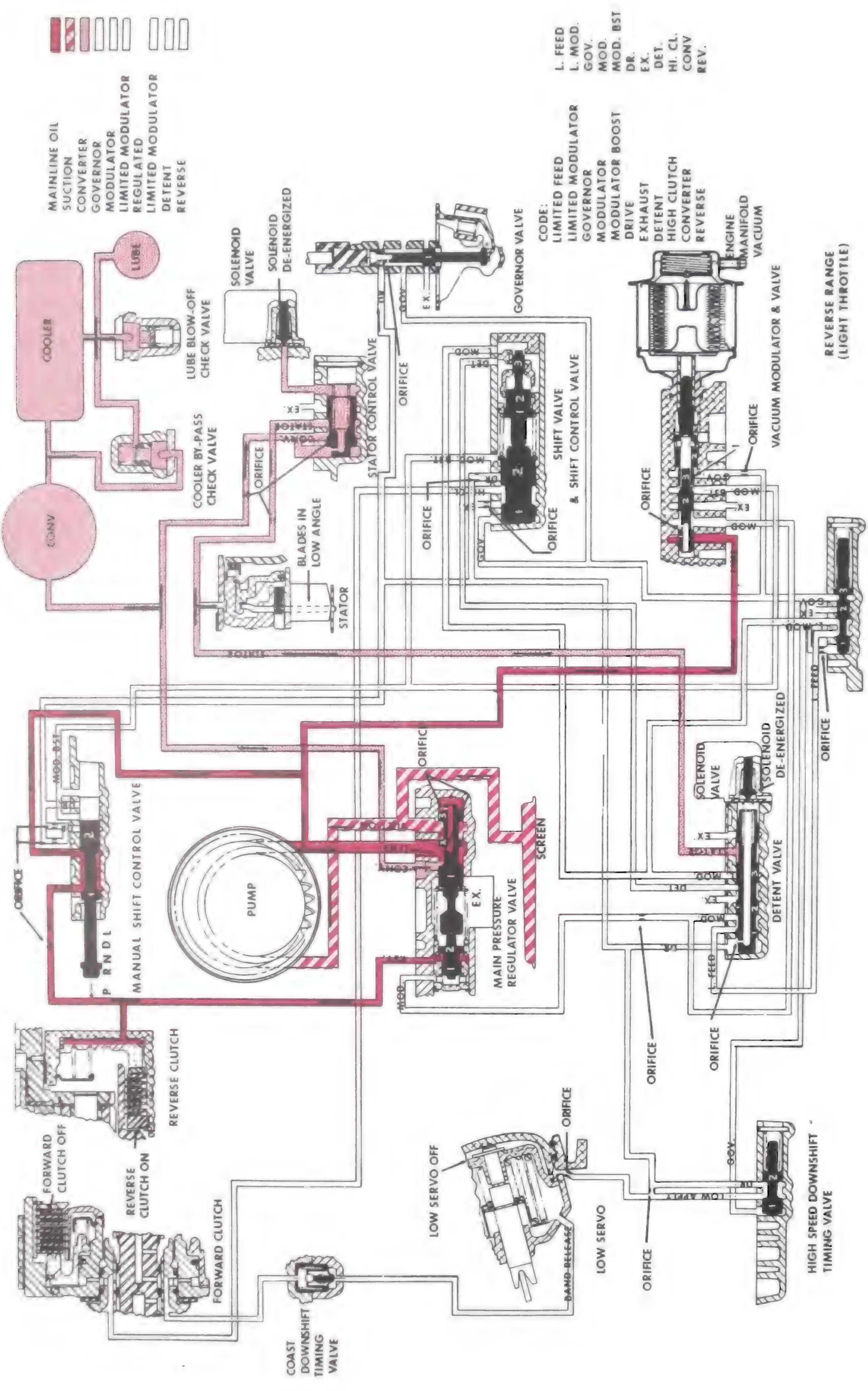


Figure 5-36—Reverse Range (Light Throttle)

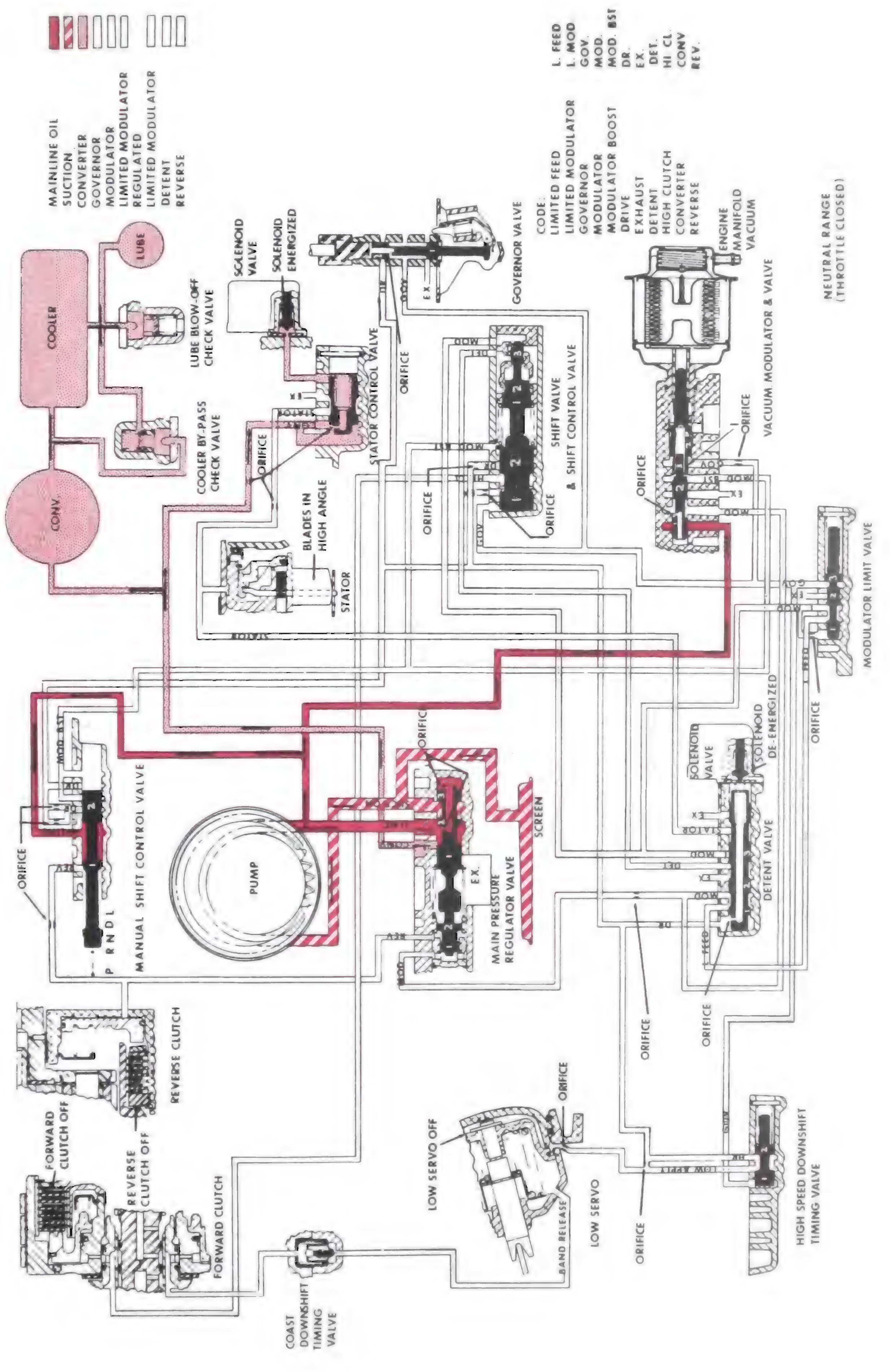


Figure 5-37—Neutral Range (Throttle Closed)

valve body. Oil pressure in this area plus governor pressure on the second land of the second modulator valve tend to move the valve against the force of its spring to regulate oil pressure leaving the valve.

Modulator pressure applies force to the left end of the boost valve causing it to move to the right. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in a higher main line pressure. With the detent valve solenoid energized, drive oil pressure will enter into the limited feed line. When limited feed pressure reaches a high enough value and exerts enough force to overcome spring pressure on the modulator limit valve, the valve will regulate governing the limited modulator and detent pressure behind the shift regulator valve.

As higher governor pressure is reached it acts on in the area between the valve body and the first land of the high speed down shift timing valve until governor pressure overcomes spring pressure and moves the valve to the right. This movement blocks the non-restricted line, routing the servo apply oil through the restricted orifice. On a down shift this restriction of flow causes the band apply to be delayed slightly and is thus timed to the forward clutch release for a smooth down shift.

m. Operation of Hydraulic Controls in Low Range (Closed Throttle Coast)

During operation in Low range, the manual shift control valve is positioned as shown in Figure 5-35. During a closed throttle coast in low range, main line oil is directed to the modulator valve and manual shift control valve. Main line oil entering the manual shift control valve is routed into drive oil passage and modulator boost passage. Oil routed in the drive oil passage is directed to the governor valve, shift valve, stator and detent valve, high speed down shift timing valve and low servo. Oil routed in the modulator boost passage is directed to the shift valve and vacuum modulator valve.

Modulator boost oil enters the shift valve between the shift valve and the shift control valve, moving the shift valve to the left and holding it in the bottom of its bore thus exhausting the forward clutch. Drive oil directed from the manual shift control valve will apply the low servo.

n. Operation of Hydraulic Controls in Reverse Range (Light Throttle)

During operation in Reverse range the manual shift control valve is positioned as shown in Figure 5-36. During light throttle in reverse, main line oil is directed to the manual shift control valve. Main line oil entering the manual shift control valve is directed to the reverse clutch and between the 1st and 2nd land of the boost valve. Main line pressure applies a force to the 2nd land of the boost valve causing it to move to the right. As the boost valve moves to the right it contacts the pressure regulator valve. This hydraulic force combined with normal spring force on the pressure regulator valve results in a higher main line pressure needed for reverse operation. When the manual shift control valve is in reverse the forward clutch and low servo are exhausted.

o. Operation of Hydraulic Controls in Neutral Range(Closed Throttle)

During operation in Neutral range, the manual shift control valve is positioned as shown in Figure 5-37. In neutral operation main line oil entering the manual shift control valve is routed to the vacuum modulator only. In neutral operation the stator control solenoid is energized switching the pitch to high angle.

NOTE: <u>At any closed throttle condition a switch on the carburetor will energize the stator control solenoid switching the pitch to high angle. By switching the pitch to high angle it will allow higher engine RPM in relation to turbine speed. With the solenoid energized the valve will bottom in its bore allowing the stator to exhaust switching the pitch to high angle.</u>

5-7 TRANSMISSION ASSEMBLY—REMOVAL AND INSTALLATION

a. Removal

1. Raise car and provide support for front and rear of car.

2. Disconnect front exhaust pipe bolts at the exhaust manifold and at the connection of the intermediate exhaust pipe location (single exhaust only). On dual exhaust the exhaust pipes need not be removed.

3. Remove pinion flange "U" bolts and slide propeller shaft toward transmission as far as possible to separate universal joint from pinion flange. Remove propeller shaft from car.

4. Place suitable jack under transmission and fasten transmission securely to jack.

5. Remove vacuum line to vacuum modulator hose from vacuum modulator.

6. Loosen cooler line nuts and

separate cooler lines from transmission.

7. Remove transmission mounting pad to cross member bolts.

8. Remove transmission cross member support to frame rail bolts. Remove cross member.

9. Disconnect speedometer cable.

10. Loosen shift linkage adjusting swivel clamp nut. Remove cotter key, spring, and washer attaching equalizer to outer range selector lever. Remove equalizer.

11. Disconnect transmission filler pipe at engine. Remove filler pipe from t.ansmission.

12. Support engine at oil pan.

13. Remove transmission flywheel cover pan to case tapping screws. Remove flywheel cover pan.

14. Mark flywheel and converter pump for reassembly in same position, and remove three converter pump to flywheel bolts.

15. Remove transmission case to engine block bolts.

CAUTION: Install Tool J-21366 to retain converter.

16. Move transmission rearward to provide clearance between converter pump and crankshaft. Lower transmission and move to bench.

b. Installation

1. Assemble transmission to suitable transmission jack and raise transmission into position. Rotate converter to permit coupling of flywheel and converter with original relationship.

2. Install transmission case to engine block bolts. Torque to 30-40 ft. lbs. Do not overtighten.

3. Install flywheel to converter pump bolts. Torque to 30-40 ft. lbs.

4. Install transmission cross member support. Install mounting pad to cross member.

5. Remove transmission jack and engine support.

6. Install transmission flywheel cover pan with tapping screws.

7. Install transmission filler pipe using a new "O" ring.

8. Reconnect speedometer cable.

9. Install propeller shaft. Connect propeller shaft to pinion flange.

10. Reinstall front exhaust crossover pipe.

11. Install oil cooler lines to transmission.

12. Install vacuum line to vacuum modulator.

13. Fill transmission with oil as follows:

a. Add 4 pints of oil.

b. Start engine in neutral. DO NOT RACE ENGINE. Move manual control lever through each range.

c. Check oil level, adjust oil level to full mark on dipstick, only when oil is hot.

5-8 ADJUSTMENT ON CAR

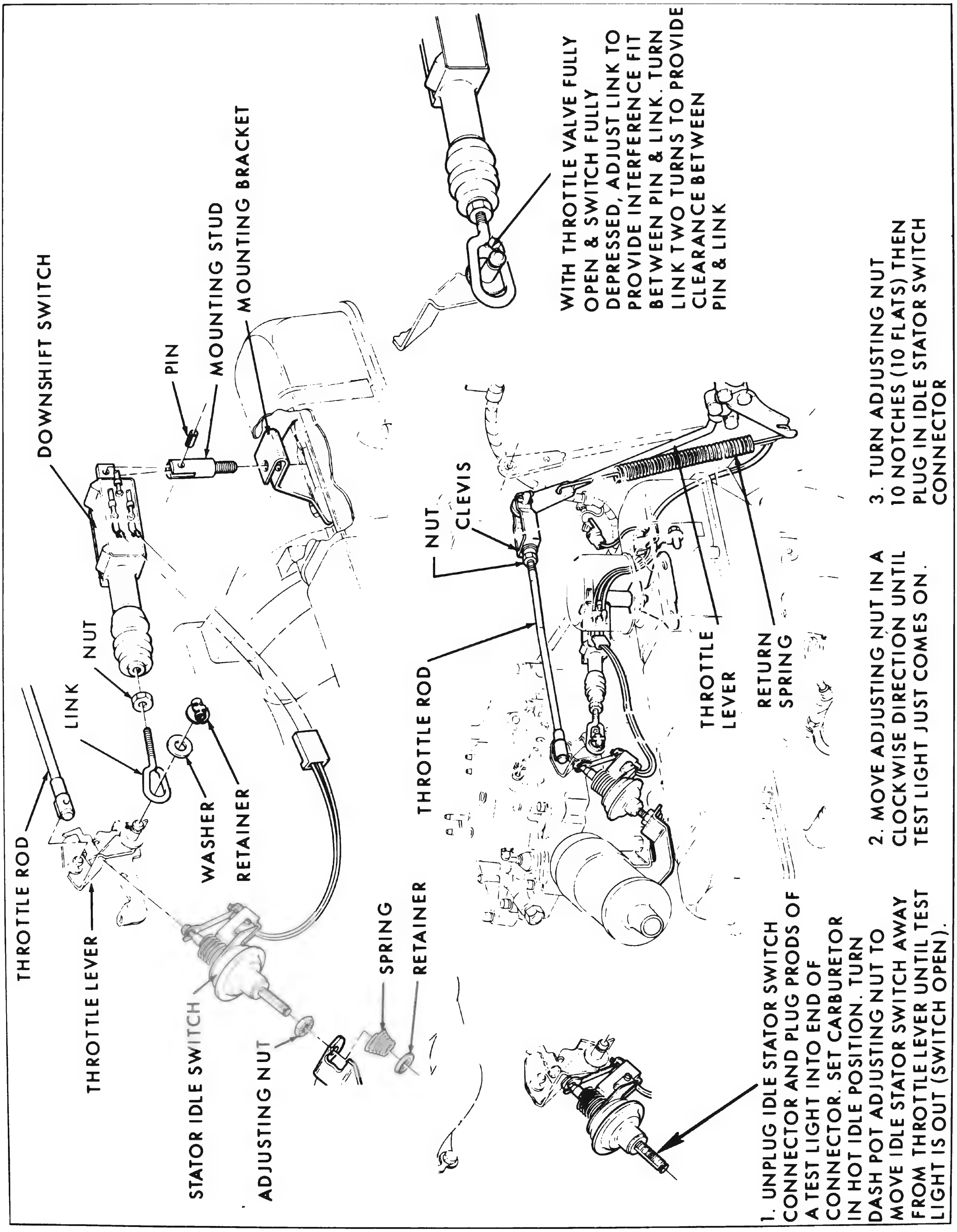


Figure 5-38—Transmission Control Switch Adjustments

SECTION 5-C

TRANSMISSION REMOVAL AND INSTALLATION DISASSEMBLY AND ASSEMBLY

CONTENTS OF SECTION 5-C

5-9 DISASSEMBLY OF TRANSMISSION TO REMOVE MAJOR PARTS AND UNITS

1. Preliminary Instructions

a. Before starting disassembly of the transmission it should be thoroughly cleaned externally to avoid getting dirt inside.

b. Place transmission on a CLEAN work bench and use CLEAN tools during disassembly. Provide CLEAN storage space for parts and units removed from transmission. An excellent working arrangement is provided by assembling the transmission to Holding Fixture J-8762. See Figure 5-100.

c. The transmission contains parts which are ground and highly polished, therefore, parts should be kept separated to avoid nicking and burring surfaces.

d. When disassembling transmission carefully inspect all gaskets at times of removal. The imprint of parts on both sides of an old gasket will show whether a good seal was obtained. A poor imprint indicates a possible source of oil leakage due to gasket condition, looseness of bolts, or uneven surfaces of parts.

e. None of the parts require forcing when disassembling or assembling transmission. Use a rawhide or plastic mallet to separate tight fitting cases - do not use a hard hammer.

5-10 REMOVAL OF OIL PAN, OIL STRAINER AND PIPE, VALVE BODY, LOW SERVO COVER AND PISTON ASSEMBLY

a. Removal of Oil Pan

NOTE: Transmission need not be removed from car to perform the following operations in Steps 3 through 12. Subparagraph d. Steps 1 through 5.

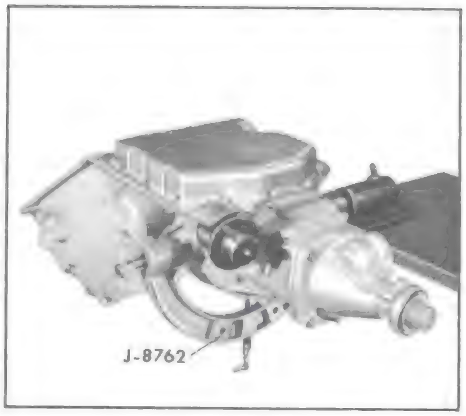


Figure 5-100

1. If transmission has been removed from car, assemble transmission in Fixture J-8763. See Figure 5-100.

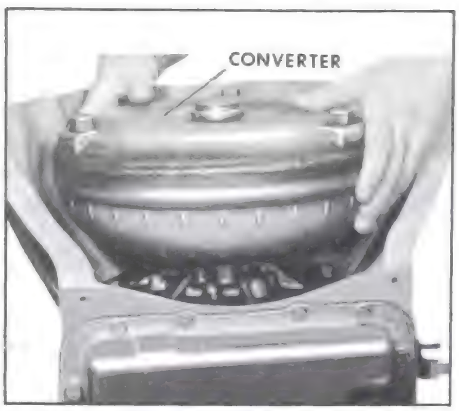


Figure 5-101

2. With transmission in horizontal position pull converter from case. See Figure 5-101.

Figure 5-102

3. Remove fourteen (14) oil pan attaching bolts using a 1/2" socket. See Figure 5-102.

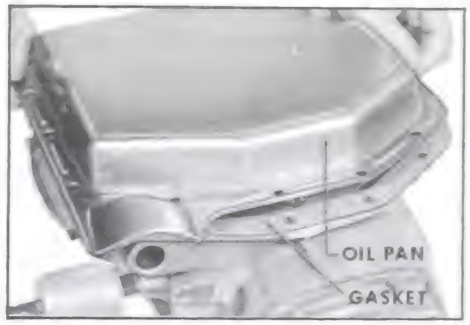


Figure 5-103

4. Remove oil pan and gasket from transmission. See Figure 5-103.

b. Removal of Oil Strainer and Pipe

1. Remove bolt retaining oil strainer to valve body using a 1/2" socket. See Figure 5-104.

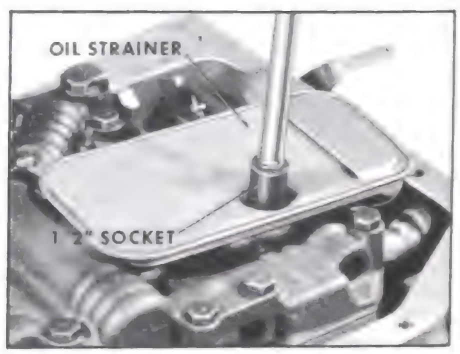


Figure 5-104

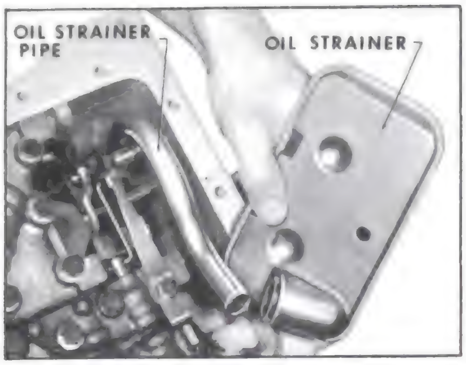


Figure 5-105

2. With a twisting motion remove oil strainer from oil strainer pipe. See Figure 5-105.

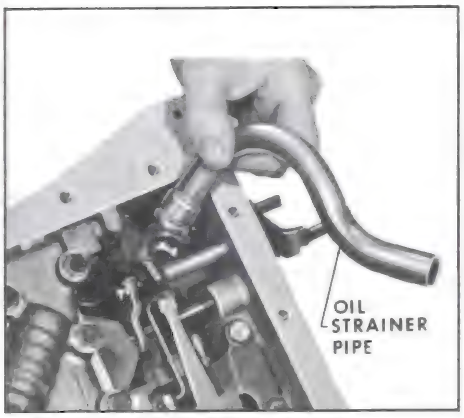


Figure 5-106

3. Lift oil strainer pipe from transmission case. See Figure 5-106.

Figure 5-107

4. Examine oil strainer to case oil seal. If nicked, torn or worn, remove seal. See Figure 5-107.

Figure 5-108

5. Examine oil strainer to oil strainer pipe grommet. If nicked, torn or worn, remove grommet. See Figure 5-108.

c. Removal of Valve Body

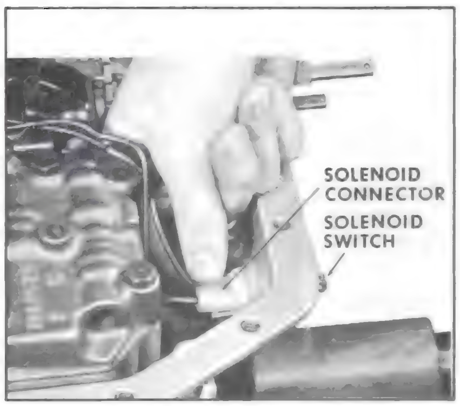


Figure 5-110

1. Disconnect solenoid connector from solenoid switch. See Figure 5-110.

Figure 5-111

2. Remove solenoid switch from case. Inspect switch "O" ring. If nicked, torn or worn replace. See Figure 5-111.

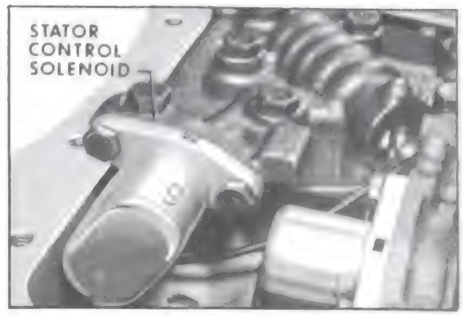


Figure 5-112

3. With a grease pencil mark stator control solenoid with an "S". This "S" will identify stator control solenoid for re-assembly. See Figure 5-112.

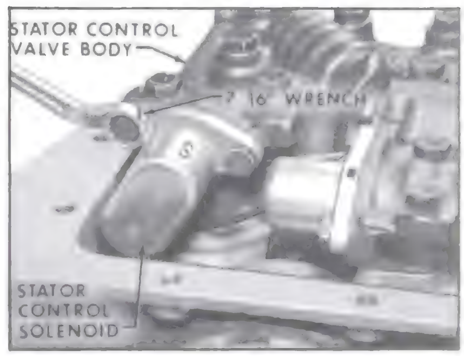


Figure 5-113

4. Remove two (2) solenoid to stator control valve body retaining bolts with 7/16" wrench. Remove stator control solenoid gasket. See Figure 5-113.

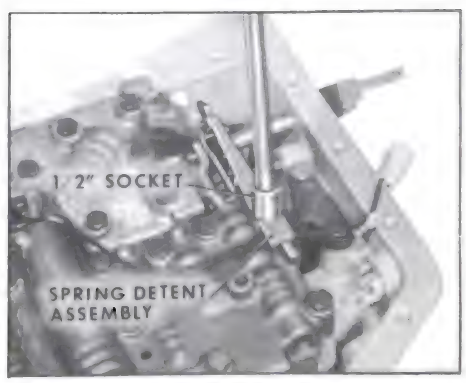


Figure 5-114

5. Remove spring detent assembly bolt with a 1/2" socket. Remove spring detent assembly from valve body. See Figure 5-114.

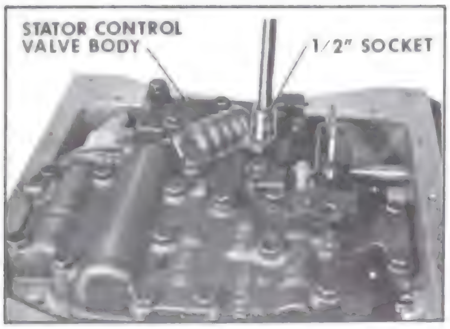


Figure 5-115

6. Remove seven (7) bolts retaining stator control valve body to transmission case using a 1/2" socket. Remove stator control valve body. See Figure 5-115.

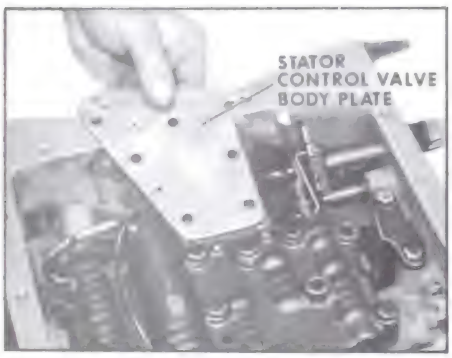


Figure 5-116

7. Remove stator control valve body plate. See Figure 5-116.

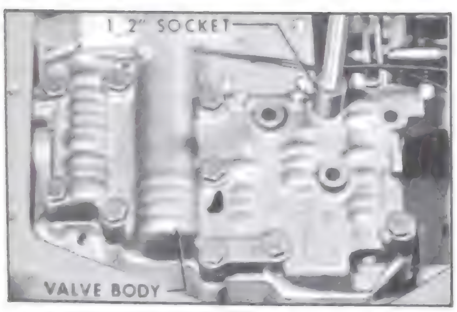


Figure 5-117

8. Remove eleven (11) valve body to case bolts only using a 1/2" socket. Do not remove valve body. See Figure 5-117.

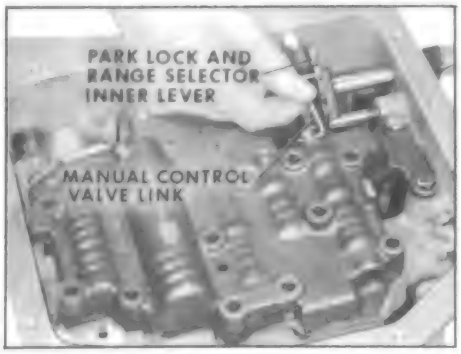


Figure 5-118

9. Remove manual control valve link by rotating valve body in a counterclockwise direction to remove link from Park lock and range selector inner valve. See Figure 5-118.

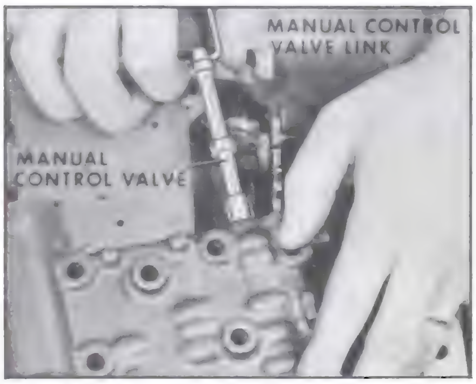


Figure 5-119

10. Remove manual control valve and link from valve body assembly. Remove valve body. See Figure 5-119.

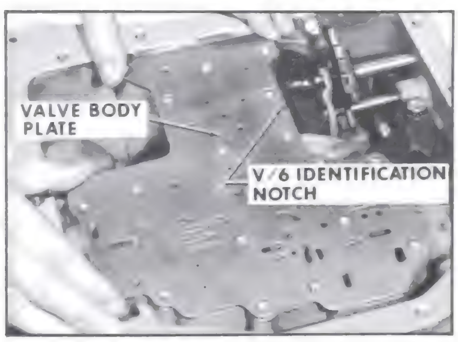


Figure 5-120

11. Remove valve body plate. See Figure 5-120.

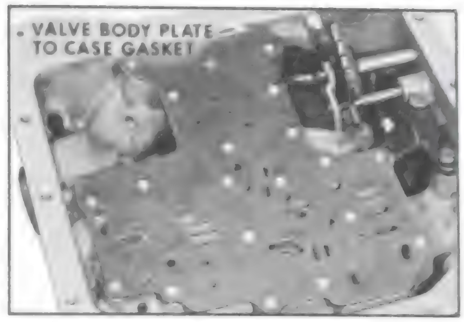


Figure 5-121

12. Remove valve body plate to case gasket. See Figure 5-121.

d. Removal of Low Servo Cover and Piston Assembly

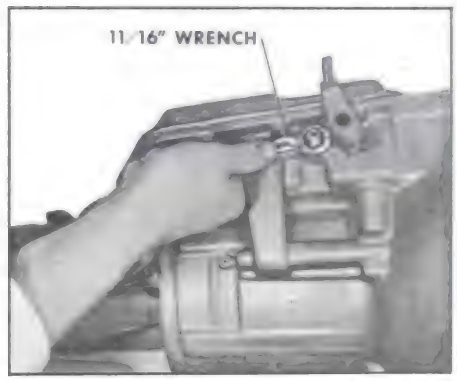


Figure 5-122

1. Release tension on low band adjusting screw retaining nut. Release tension on low band by turning adjusting screw in a counterclockwise direction. Use a 7/32" Allen Wrench. See Figure 5-122.

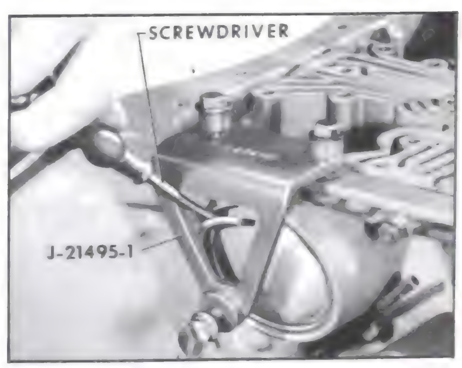


Figure 5-123

2. Remove low servo cover snap ring. Use tool J-21495-1 to compress servo cover so snap ring can be removed. See Figure 5-123.

Figure 5-124

3. Remove tool J-21495-1 from case. Remove low servo cover. NOTE: If necessary aid removal with screwdriver. See Figure 5-124.

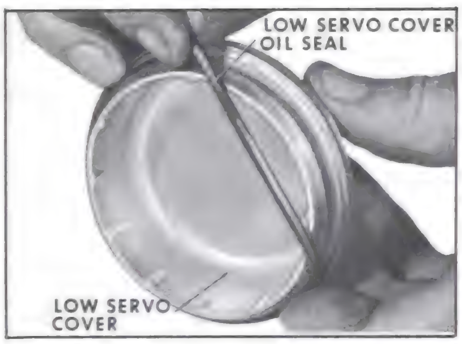


Figure 5-125

4. Inspect low servo cover seal. If nicked, torn or worn discard. See Figure 5-125.

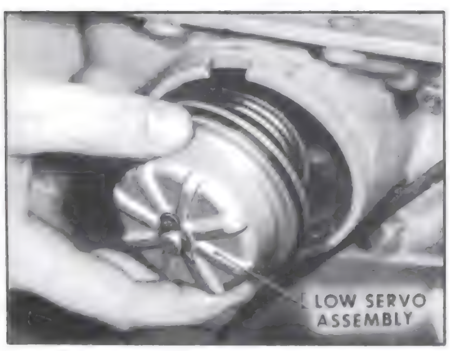


Figure 5-126

5. Remove low servo piston assembly from case. See Figure 5-126.

5-11 REMOVAL OF OIL PUMP, FORWARD CLUTCH, AND LOW BAND

a. Removal of Oil Pump

1. With transmission in vertical position, remove eight (8) pump attaching bolts with "O" ring

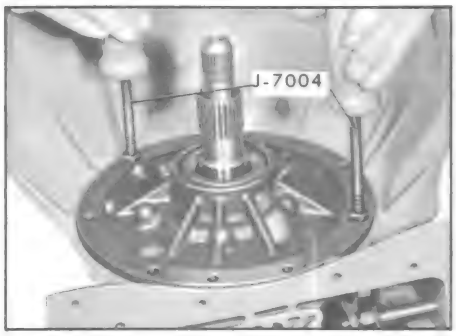


Figure 5-127

seals, then install Slide Hammers J-7004 into threaded holes in pump. Using slide hammers, loosen pump from case. Remove pump and gasket from case. See Figure 5-127.

b. Removal of Forward Clutch

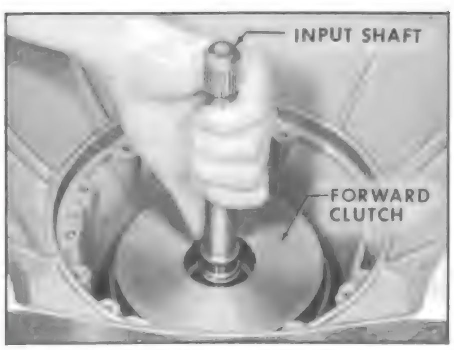


Figure 5-128

1. Remove input shaft from forward clutch drum. See Figure 5-128.

Figure 5-129

2. Examine input shaft oil rings. If nicked or worn, remove rings. See Figure 5-129.

Figure 5-130

3. Remove forward clutch assembly by pulling straight out of case. Make certain low band has been released before attempting to remove forward clutch. See Fig- 5-130.

c. Removal of Low Band

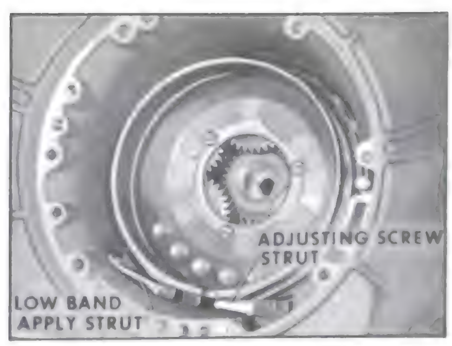


Figure 5-131

1. Remove low band and struts from inside the case. See Figure 5-131.

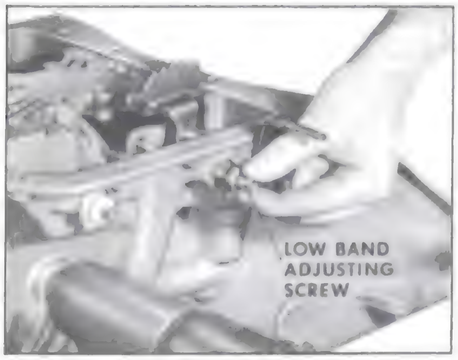


Figure 5-132

2. Remove low band adjusting screw. See Figure 5-132.

5-12 REMOVE SPEEDOMETER DRIVEN GEAR, REAR BEARING RETAINER, RETAINER OIL SEAL, RETAINER BUSHING, AND SPEEDOMETER DRIVE GEAR

a. Removal of Speedometer Driven Gear

NOTE: Transmission need not be removed from the car to perform the following operations, paragraph 5-12 and 5-13.

Figure 5-133

1. With transmission in horizontal position, remove speedometer driven gear sleeve retainer with a 1/2" wrench. See Figure 5-133.

Figure 5-134

2. Remove speedometer driven gear sleeve. See Figure 5-134.

b. Removal of Rear Bearing Retainer

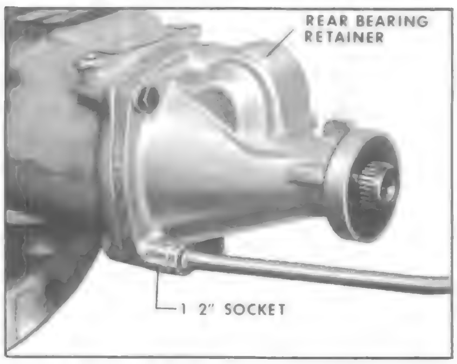


Figure 5-135

1. Remove four (4) rear bearing retaining bolts with a 9/16" socket. Remove rear bearing retainer from case. See Figure 5-135.

Figure 5-136

2. Remove rear bearing retainer oil seal. See Figure 5-136.

c. Removal of Rear Bearing Retainer Oil Seal

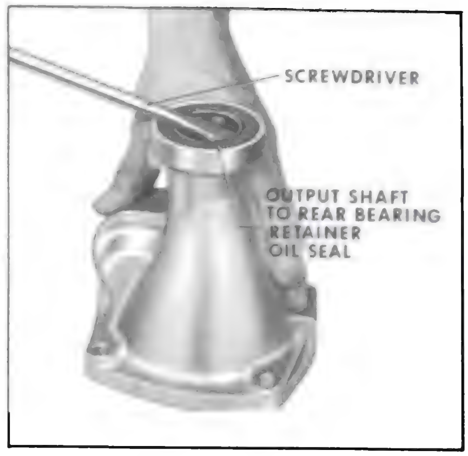


Figure 5-137

1. Inspect and if necessary remove output shaft to rear bearing retainer oil seal. See Figure 5-137.

d. Removal of Rear Bearing Retainer Bushing

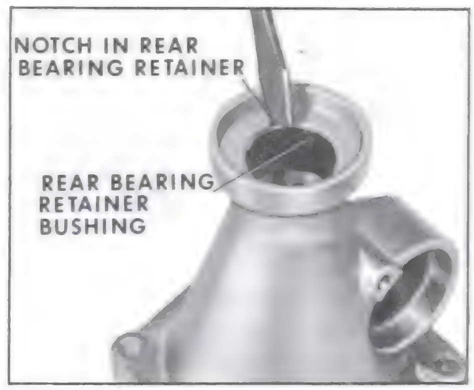


Figure 5-138

1. Inspect and if necessary replace rear bearing retainer bushing. Place screwdriver in notch in rear bearing retainer, then tap screwdriver with hammer to collapse bushing. See Figure 5-138.

e. Removal of Speedometer Driving Gear

1. Place transmission in Park range, then remove speedometer

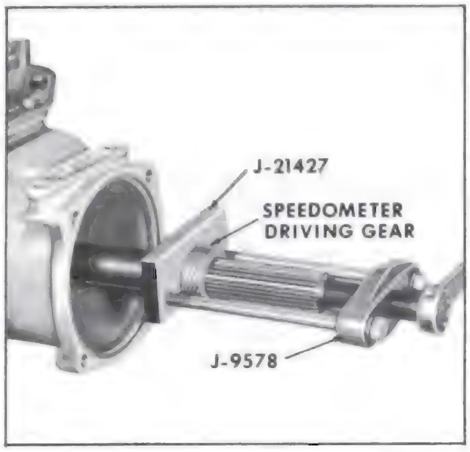


Figure 5-140

driving gear with J-9578. See Figure 5-140.

5-13 REMOVAL OF GOVERNOR AND VACUUM MODULATOR

a. Removal of Governor

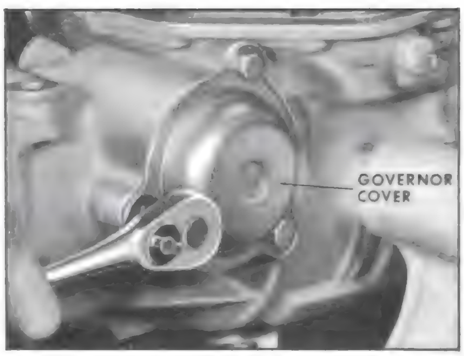


Figure 5-141

1. Remove three (3) attaching bolts retaining governor cover to case using a 1/2" socket. Remove cover and gasket. See Figure 5-141.

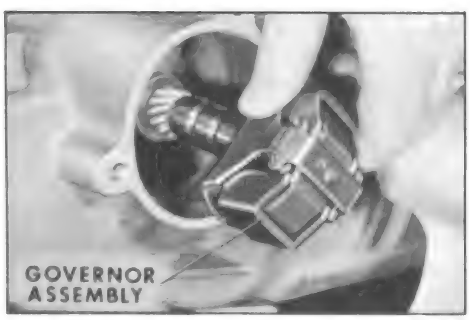


Figure 5-142

2. With a twisting motion slide governor assembly out of its bore in case. See Figure 5-142.

b. Removal of the Vacuum Modulator Assembly

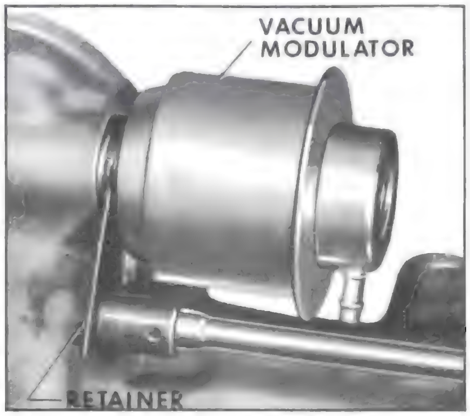


Figure 5-143

1. Remove vacuum modulator retainer bolt and retainer using a 1/2" socket. Remove vacuum modulator and valve assembly. See Figure 5-143.

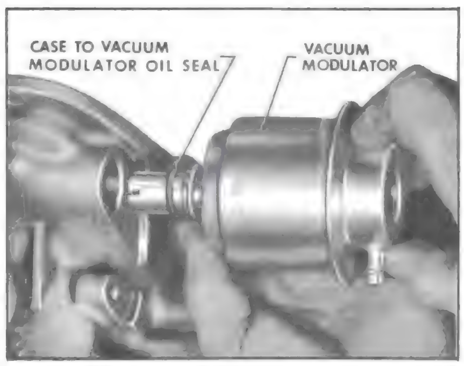


Figure 5-144

2. Inspect and if necessary remove vacuum modulator to case oil seal. See Figure 5-144.

5-14 REMOVAL OF PLANETARY GEAR SET, REVERSE CLUTCH AND PARKING LOCK MECHANISM

a. Removal of Planetary Gear Set

1. Remove planet carrier assembly from case, using care not to

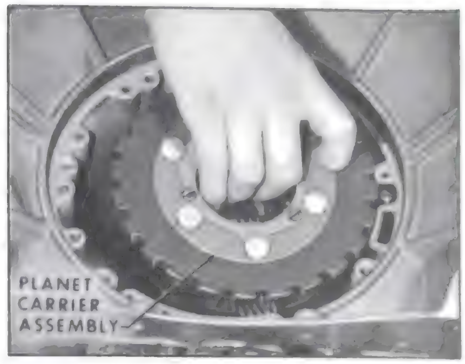


Figure 5-145

damage case bushing. See Figure 5-145.

Figure 5-146

2. Remove reverse ring gear from case. See Figure 5-146.

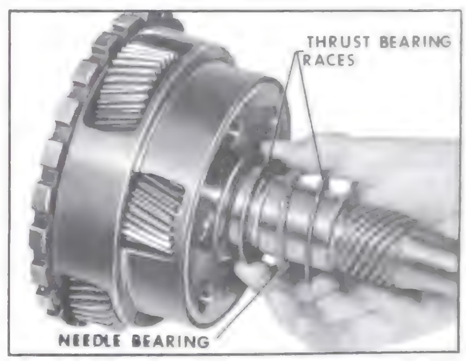


Figure 5-147

3. Remove needle bearing and two (2) bearing races from rear of planet carrier. See Figure 5-147.

b. Removal of Reverse Clutch

1. Place transmission in vertical position and remove reverse

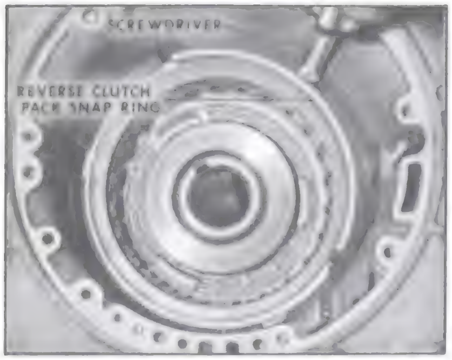


Figure 5-148

clutch pack snap ring with screw-driver. See Figure 5-148.

Figure 5-150

2. Lift reverse clutch pressure plate from transmission case. See Figure 5-150.

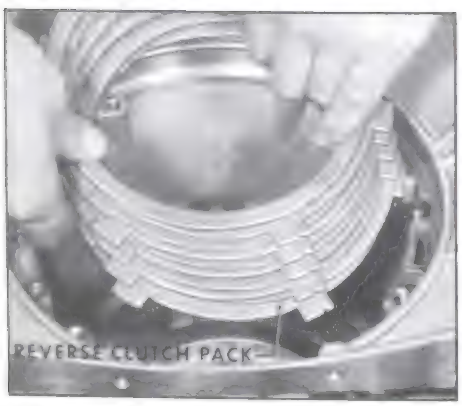


Figure 5-151

3. Remove reverse clutch pack from transmission case. See Figure 5-151.

Figure 5-152

4. Remove reverse clutch cushion spring. See Figure 5-152.

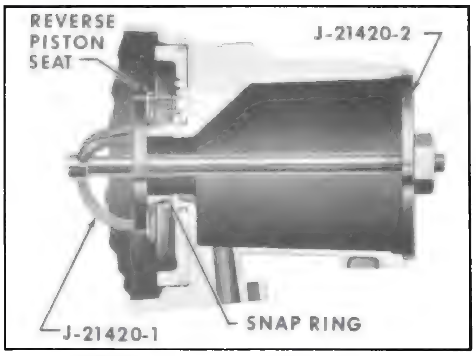


Figure 5-153

5. To remove reverse piston, center tool J-21420-1 on reverse piston return seat. Install Flat Plate J-21420-2 over threaded shaft at rear of case. Tighten wing nut to compress piston return seat; then remove snap ring with Pliers J-5586. See Figure 5-153.

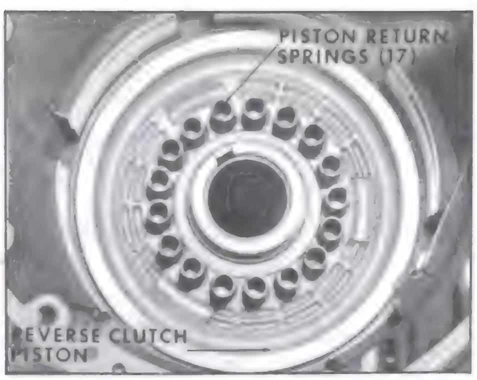


Figure 5-154

6. Remove tool J-21420-2 being careful that piston return seat does not catch in snap ring groove. Lift off piston return seat and remove seventeen (17) piston return springs. See Figure 5-154.

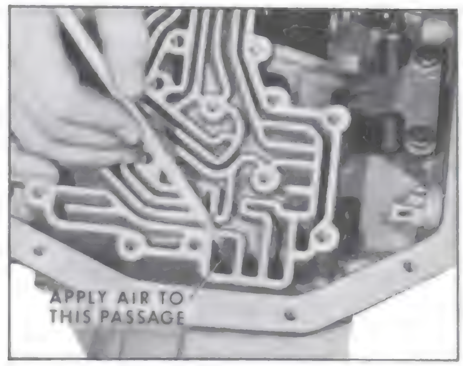


Figure 5-155

7. Place transmission in a horizontal position and remove reverse clutch piston with compressed air. As air is applied to the rear surface of the piston, it will pop out far enough so it can be removed. Insert air nozzle to rear of case as shown in figure. See Figure 5-155.

Figure 5-156

8. Examine reverse clutch piston outer seal. If nicked, torn or worn, remove seal. See Figure 5-156.

9. Examine reverse clutch piston inner seal. If nicked, torn or

Figure 5-157

worn, remove seal. See Figure 5-157.

c. Removal of Range Selector Lever and Shaft, and Parking Lock Actuator

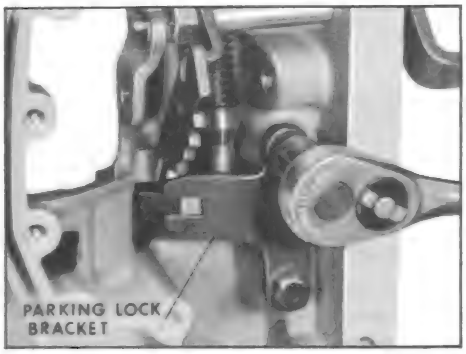


Figure 5-158

1. Remove two (2) parking lock bracket bolts with 1/2" socket. Remove parking lock bracket. See Figure 5-158.

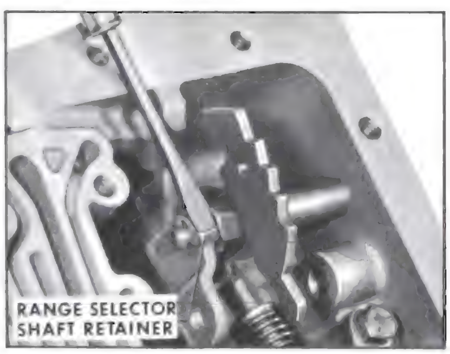


Figure 5-160

2. Remove range selector shaft retainer. See Figure 5-160.

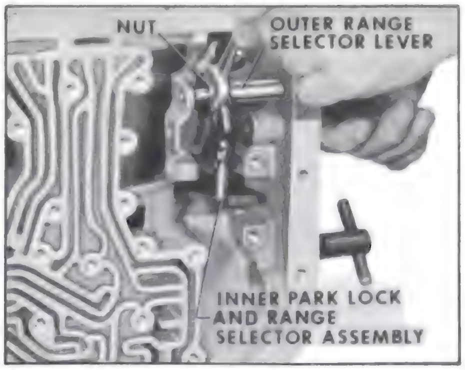


Figure 5-161

3. With a 9/16" wrench fully loosen nut that retains outer range selector lever to inner park lock and range selector lever. See Figure 5-161.

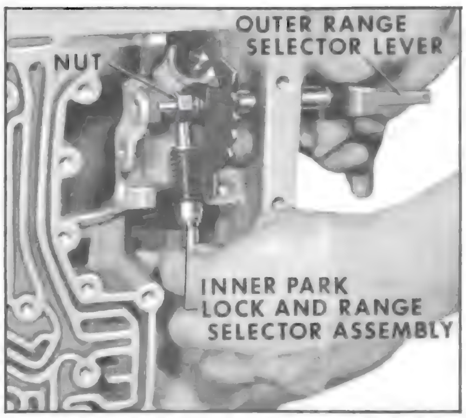


Figure 5-162

4. Slide outer range selector lever out of case. Remove nut, inner park lock and range selector lever. See Figure 5-162.

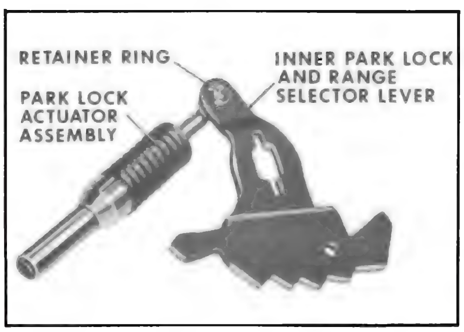


Figure 5-163

5. Remove retaining ring which holds inner park lock and range selector to park lock assembly. See Figure 5-163.

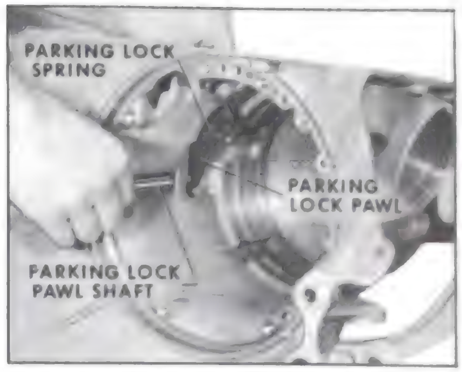


Figure 5-164

6. Slide parking lock pawl shaft out of parking lock pawl. Remove parking lock pawl and spring. See Figure 5-164.

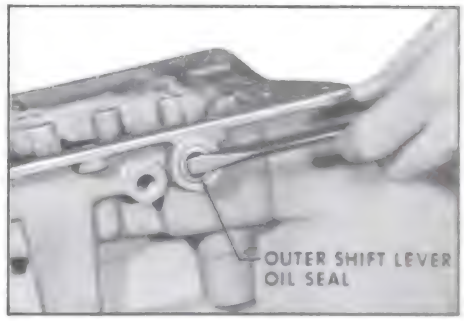


Figure 5-165

7. Examine outer shift lever oil seal. If nicked, torn or worn, replace seal. See Figure 5-165.

d. Removal of Case Bushing

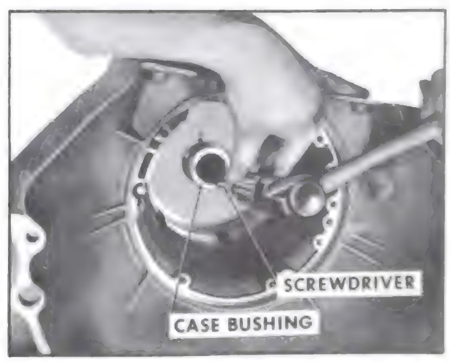


Figure 5-166

1. Inspect case bushing for nicks, scoring or excessive wear. If damaged, replace as follows: Place screwdriver in notch in case, then tap screwdriver with

hammer to collapse bushing. See Figure 5-166.

5-15 VALVE BODY DISASSEMBLY INSPECTION AND REASSEMBLY

a. Disassembly

NOTE: Transmission need not be removed from the car to perform the following operations. Paragraph 5-15, 5-16 and 5-17.

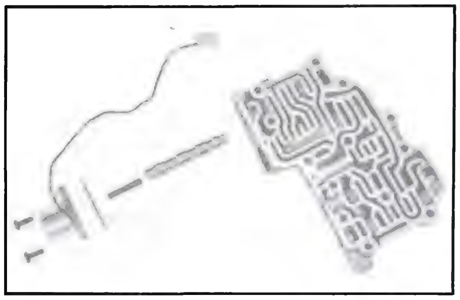


Figure 5-167

1. Remove two (2) bolts attaching stator and detent solenoid valve. Remove the solenoid valve, gasket, spring and stator and detent valve. See Figure 5-167.

NOTE: Notice cutout notch on solenoid valve gasket.

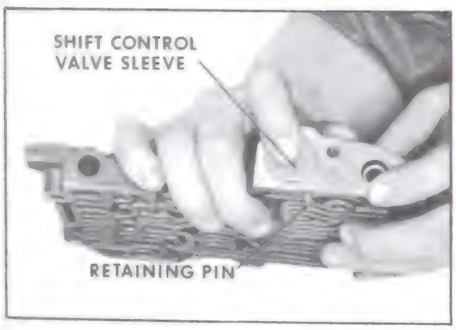


Figure 5-168

2. Depress shift control valve sleeve and remove retaining pin by turning valve body over so pin will fall free. Remove shift control valve sleeve, shift control valve, spring, washer, and shift valve. See Figure 5-168.

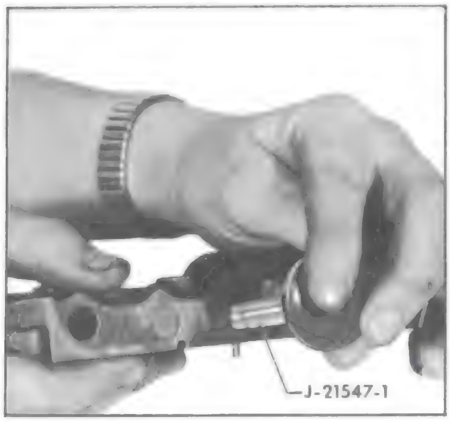


Figure 5-170

3. Depress modulator limit spring with tool J-21547-1. Turn valve body over and retaining pin will fall free. Remove spring and valve from body. See Figure 5-170.

NOTE: Modulator limit spring is under moderate pressure. Care should be exercised in removal.

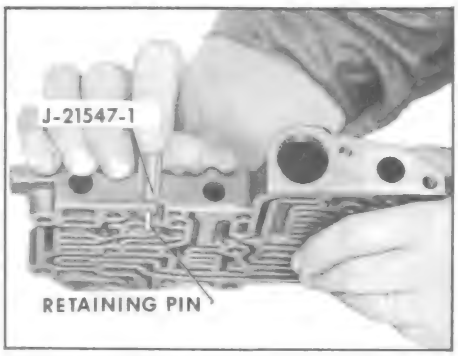


Figure 5-171

4. Depress high speed down shift timing valve plug and remove pin by turning valve body over so pin will fall free. See Figure 5-171.

b. Inspection

1. Thoroughly clean all valves and valve body in solvent. Inspect valves and valve body for evidence of wear or damage due to foreign material. Dry valve body and valves with clean air blast.

2. Test each valve in its bore. All valves must move freely of their own weight.

c. Reassembly of Valve Body

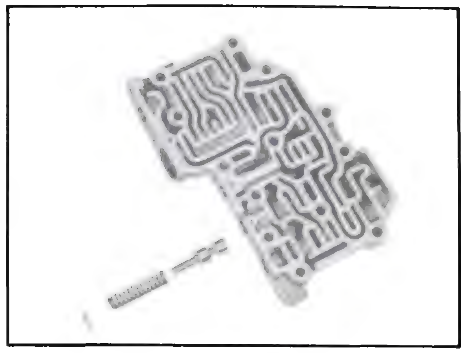


Figure 5-172

1. Install high speed downshift timing valve and spring. Depress spring with J-21547-1 and install retaining pin. See Figure 5-172.

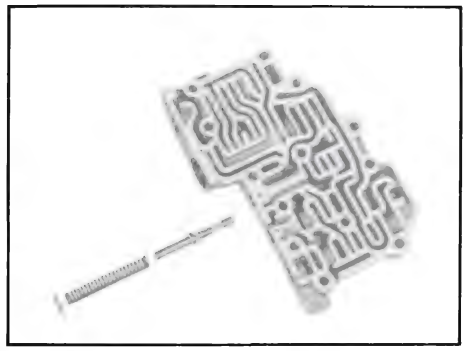


Figure 5-173

2. Install modulator limit valve, and spring into bore of valve body. With aid of tool J-21361 compress spring and install retaining pin. See Figure 5-173.

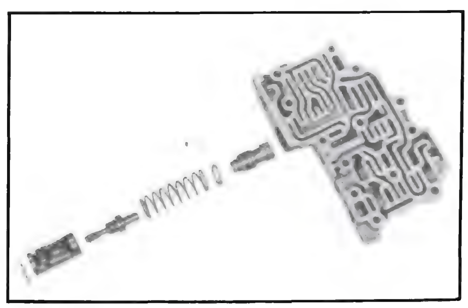


Figure 5-174

3. Install shift valve, washer, spring, shift control valve and shift control valve sleeve. Depress shift control valve sleeve

with thumb and install retaining pin. See Figure 5-174.

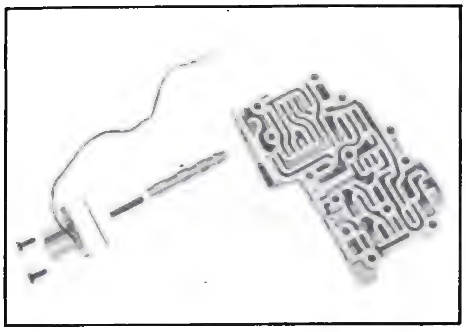


Figure 5-175

4. Install detent valve and spring. Install gasket to solenoid with notch facing bottom of valve body. Install solenoid to valve body using two 7/16" bolts. See Figure 5-175.

5-16 STATOR CONTROL VALVE BODY DISASSEMBLY AND REASSEMBLY

a. Disassembly

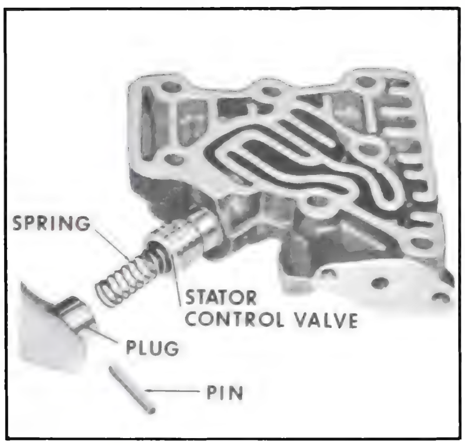


Figure 5-176

1. Compress stator control valve plug. Turn valve body over and retaining pin will fall free. Remove plug, spring and valve from body. See Figure 5-176.

b. Reassembly

2. Install stator control valve, spring and plug into bore of valve

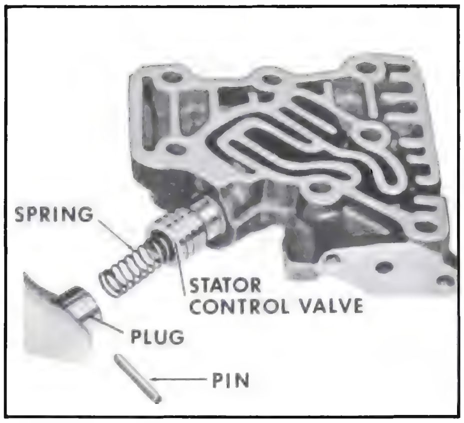


Figure 5-177

body. Compress plug and install retaining pin. See Figure 5-177.

5-17 LOW SERVO DISASSEMBLY AND REASSEMBLY

a. Disassembly

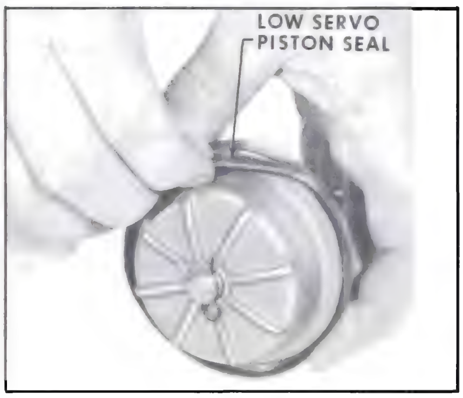


Figure 5-177A

1. Remove low servo piston seal. See Figure 5-177-A.

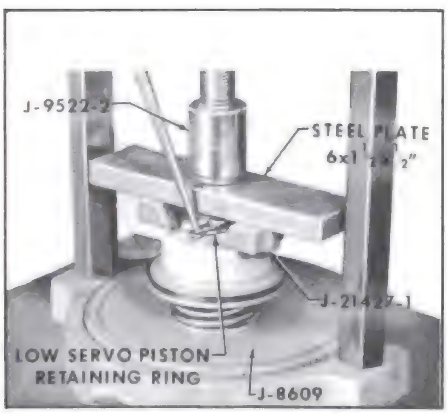


Figure 5-178

2. Compress low servo piston. EXTREME CAUTION MUST BE TAKEN WHEN THE LOW SERVO IS BEING COMPRESSED. Install J-9522-2 to hydraulic ram. Install J-21421-1 on top of servo piston. Install a piece of metal 6" x 1-1/2 x 1/2 between J-9522-2 and J-21421-1. Using hydraulic press compress piston and remove retaining pin.

NOTE: After retaining pin has been removed release hydraulic ram very slowly. See Figure 5-178.

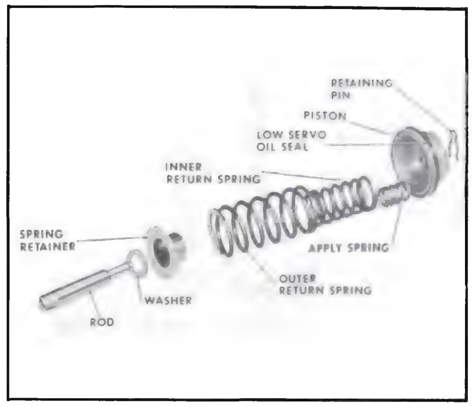


Figure 5-179

3. After hydraulic ram has been released remove piston low servo apply piston spring inner, outer return springs, spring retainer, washer and piston apply rod. See Figure 5-179.

b. Reassembly

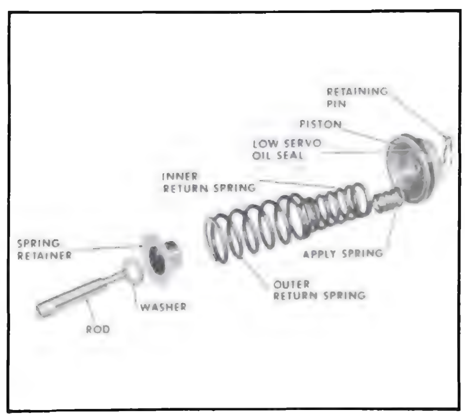


Figure 5-180

1. Assemble the inner and outer return springs into the piston. Install spring retainer. See Figure 5-180. Install this assembly into the ram press as shown in Figure 5-180.

2. Assemble tools on top of piston in same manner as removing. Center spring retainer over hole

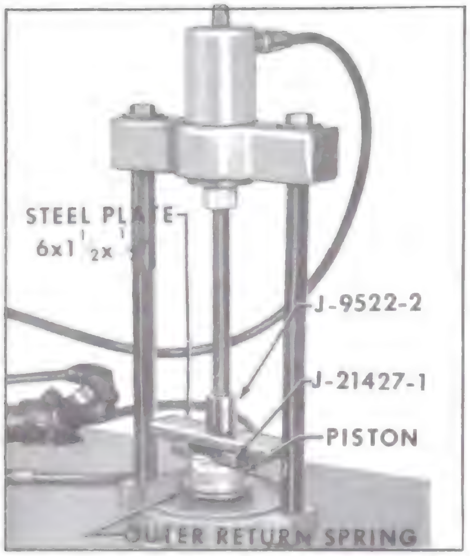


Figure 5-181

in press Plate J-8690. Compress springs. Install piston apply rod and washer through hole in press plate and install retainer pin.

CAUTION: BEFORE RELEASING RAM MAKE CERTAIN RETAINER PIN IS PROPERLY INSTALLED.

Install low servo piston seal. See Figure 5-181.

5-18 DISASSEMBLY, INSPECTION, AND THE REASSEMBLY OF THE OIL PUMP

a. Disassembly

1. Remove the two (2) hook type oil sealing rings from pump hub. See Figure 5-182.

Figure 5-182

Figure 5-183

2. Remove pump cover to forward clutch drum thrust washer. See Figure 5-183.

Figure 5-184

3. Remove oil pump to case seal and discard. See Figure 5-184.

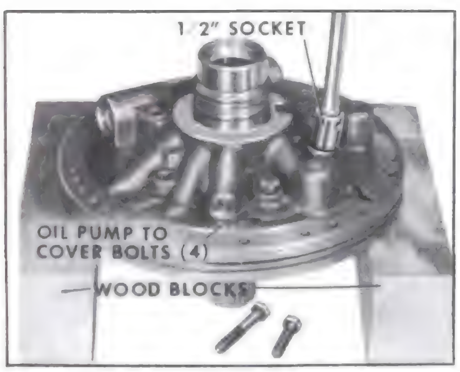


Figure 5-185

4. Support oil pump on wood blocks. Remove five (5) pump cover bolts with a 1/2" socket. Remove pump cover. See Figure 5-185.

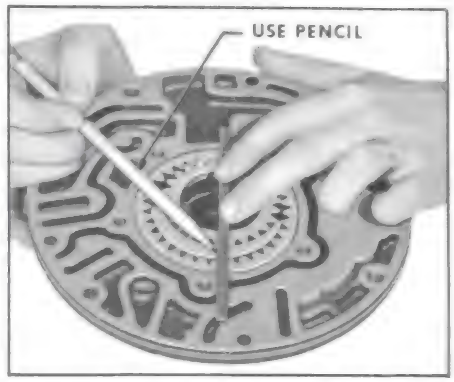


Figure 5-186

5. Mark, but do not scar, gear faces so gears can be reassembled in same manner. See Figure 5-186.

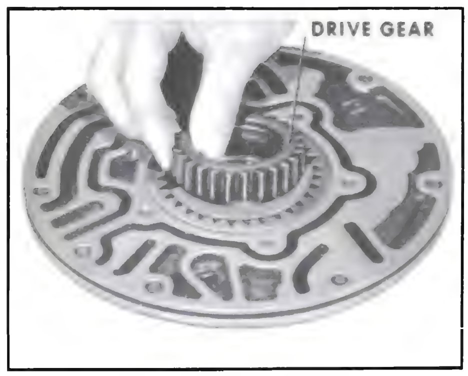


Figure 5-187

6. Remove oil pump drive gear. See Figure 5-187.

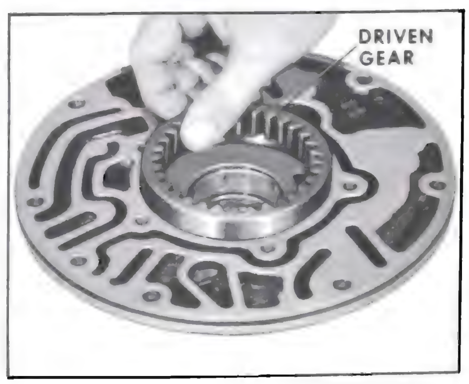


Figure 5-188

7. Remove oil pump driven gear. See Figure 5-188.

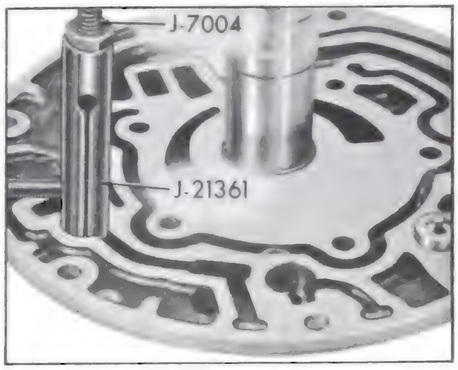


Figure 5-190

8. Remove seat, valve and spring from cooler by-pass valve and lube blow off valve. Use tool J-21361 to remove seat from bore in pump cover. See Figure 5-190.

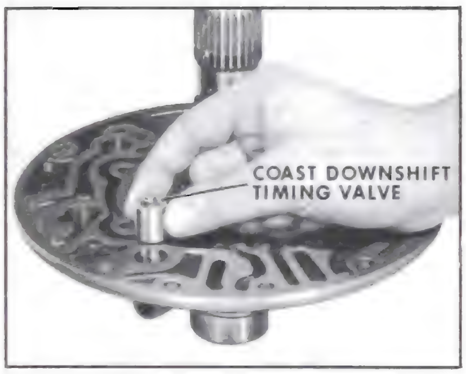


Figure 5-191

9. Remove coast downshift timing valve from the pump cover and inspect for damage. Carefully check to be sure the spring returns the ball to its seat. See Figure 5-191.

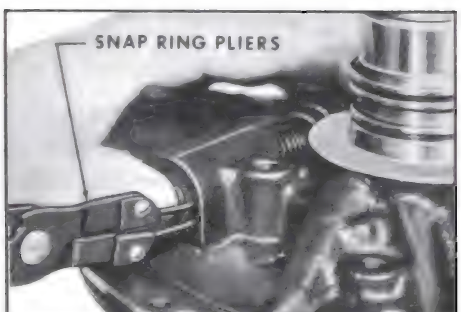


Figure 5-192

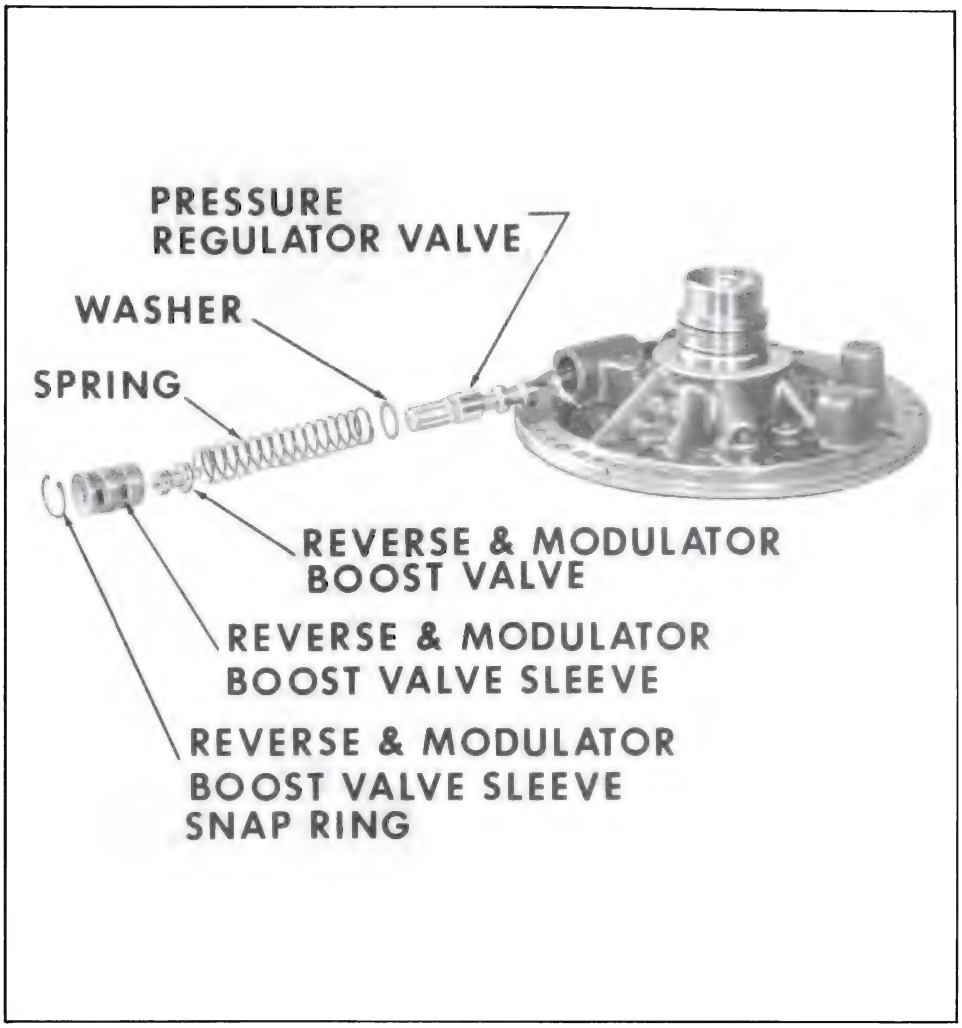


Figure 5-193

10. Compress reverse and modulator boost valve with thumb and remove retaining snap ring. See Figure 5-192.

CAUTION: Reverse and modulator boost valve sleeve is under extreme spring pressure. Extreme care should be taken after retaining snap ring has been removed.

11. After retaining snap ring has been removed, remove reverse and modulator boost valve sleeve and valve, spring, washer, and pressure regulator valve. See Figure 5-193.

12. Examine oil pump seal. If nicked, torn or worn remove seal as follows: Support oil pump body on wood blocks. Remove oil seal with a screwdriver and discard. See Figure 5-194.

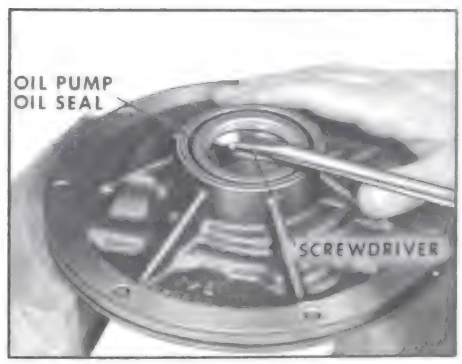


Figure 5-194

13. Check oil pump bushing for nicks, severe scoring or wear. If bushing replacement is necessary, replace pump body.

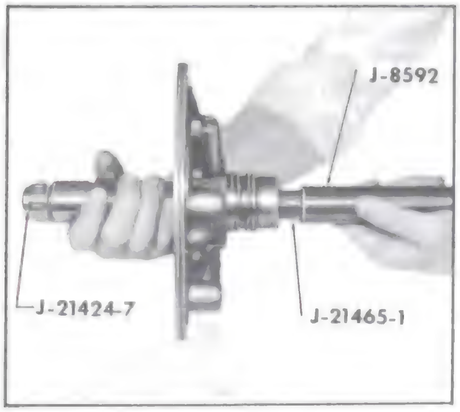


Figure 5-196

14. Check stator shaft bushing for nicks, severe scoring or wear. If bushing replacement is necessary proceed as follows: Assemble Bushing Remover J-21424-7 to Extension J-21465-13. Assemble this assembly to Drive Handle J-8592. Grasp stator shaft with hand using other hand and assembled tool drive out bushing. See Figure 5-196.

b. Inspection

1. Wash all parts in a cleaning solvent and blow out oil passages with compressed air.

2. Inspect pump gears for nicks or damage.

3. Inspect pump body for nicks or scoring.

4. Check condition of bushing in oil pump body, if damaged replace.

5. With parts clean and dry, install pump gears, noting mark on gears for identification of the side that faces the pump cover. After gears have been installed, proceed as follows:

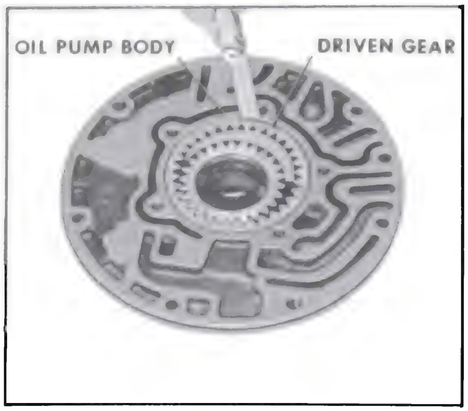


Figure 5-197

a. Check clearance between O.D. of driven gear and pump body. The clearance allowed is .0035/ .0065. See Figure 5-197.

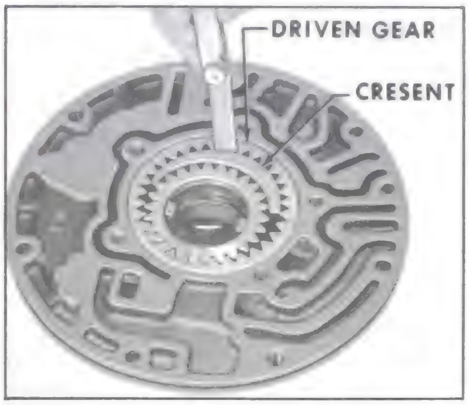


Figure 5-198

b. Check clearance between oil pump driven gear and crescent. The clearance allowed is .0005/ .0100. See Figure 5-198.

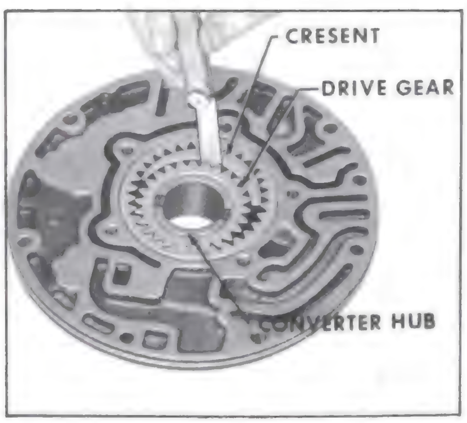


Figure 5-200

c. Install pump on converter hub. Check clearance between oil pump drive gear and crescent. The clearance allowed is .004/.009. See Figure 5-200.

Figure 5-201

d. Install pump on converter hub. With dial indicator set check end clearance. The clearance allowed is .0005/.0015. See Figure 5-201.

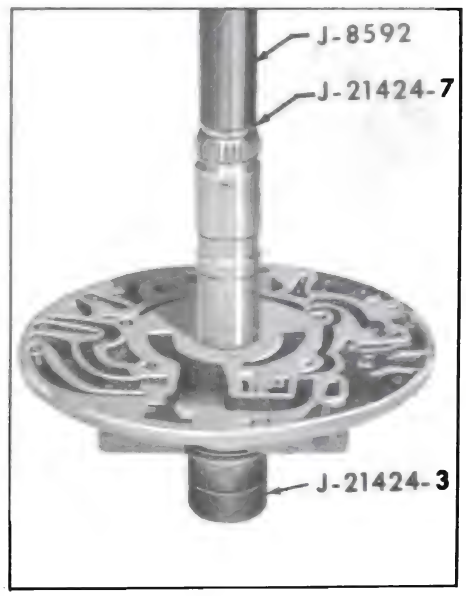


Figure 5-203

1. Install stator shaft bushing as follows: Support pump assembly on J-21424-7 before installing bushing. Install bushing into the front end of stator shaft. Using Installer J-21424-7 and Drive Handle J-8592 tap bushing into shaft until tool is flush with top of shaft. See Figure 5-203.

Figure 5-204

2. Using Installer J-21359 tap in new oil seal. See Figure 5-204.

Figure 5-205

3. Install new oil pump to case seal. See Figure 5-205.

4. Assemble pressure regulator valve, washer, spring, reverse and modulator boost valve and sleeve. See Figure 5-206.

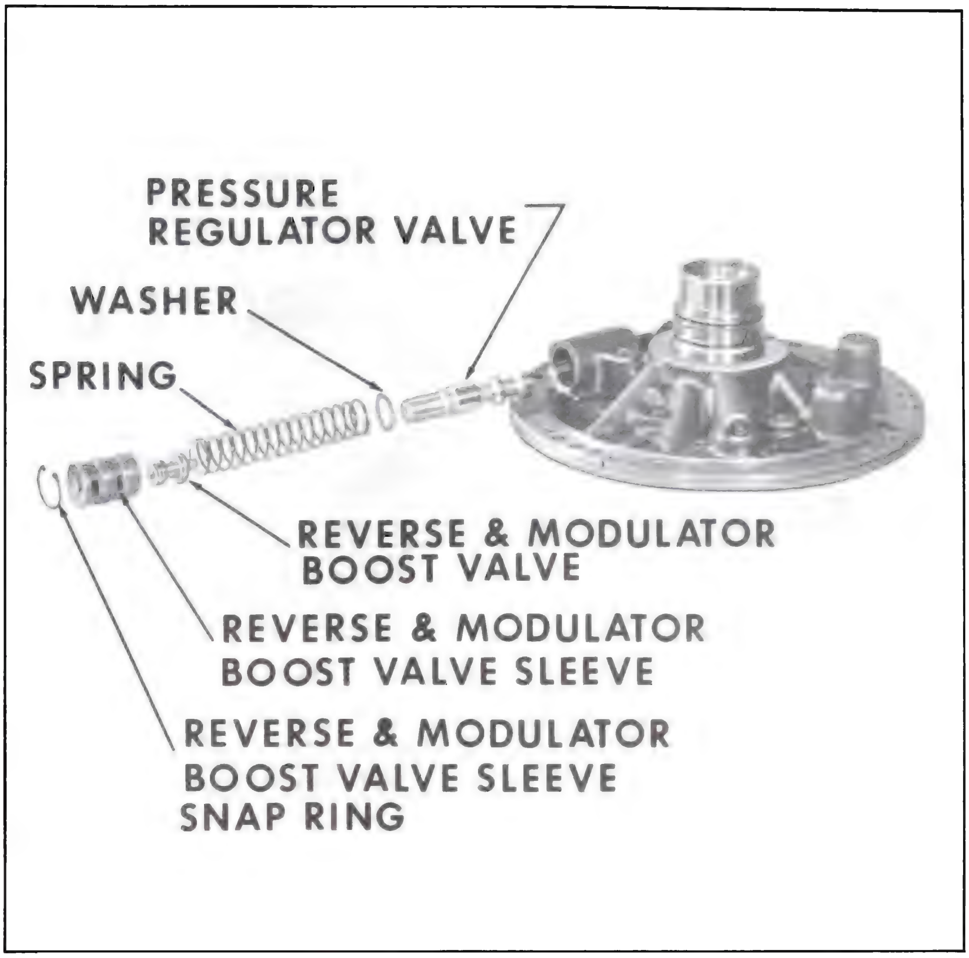


Figure 5-206

5. Compress reverse and modulator boost valve with thumb, then install retaining snap ring. See Figure 5-207.

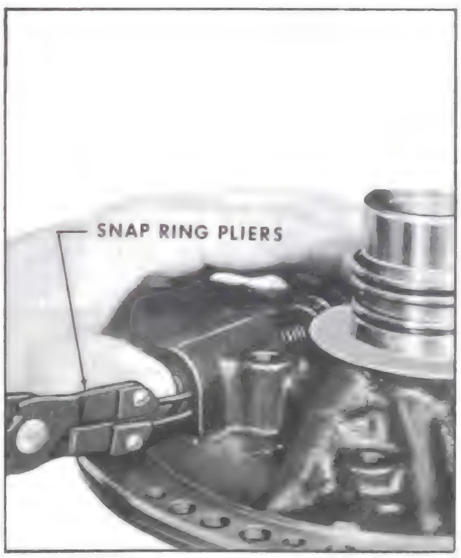


Figure 5-207

6. Install coast downshift timing valve "button end" up in cover. See Figure 5-208.

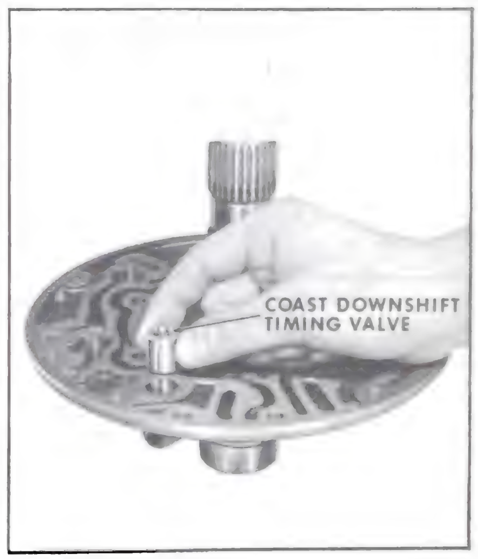


Figure 5-208

7. Install spring, valve, and seat into cooler by-pass valve and lube blow off valve. Using Tool J-21558 press seat into bore of pump body until tool bottoms on face of pump. See Figure 5-210.

Figure 5-210

NOTE: Thrust washer and oil pump sealing ring will be installed during later operation.

Figure 5-211

8. Install pump cover to pump body. Install five (5) retaining bolts but do not tighten. Place Tool J-21368 around pump to obtain proper alignment. Tighten bolts to 16-24 ft. lbs. torque. See Figure 5-211.

NOTE: The bolt location at the pressure regulator takes a longer bolt.

5-19 DISASSEMBLY, INSPECTION, and REASSEMBLY OF FORWARD CLUTCH

a. Disassembly

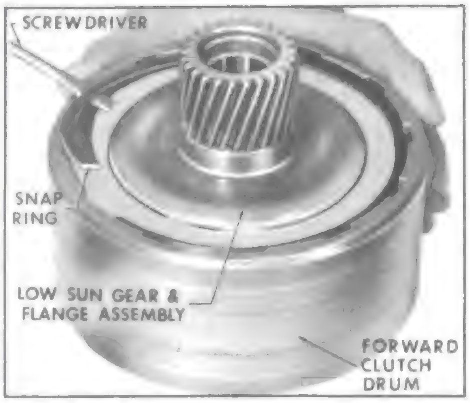


Figure 5-212

1. Remove low sun gear and flange assembly retaining snap ring. See Figure 5-212.

Figure 5-213

2. Remove low sun gear and flange assembly. See Figure 5-213.

Figure 5-214

3. Remove clutch hub rear thrust washer. See Figure 5-214.

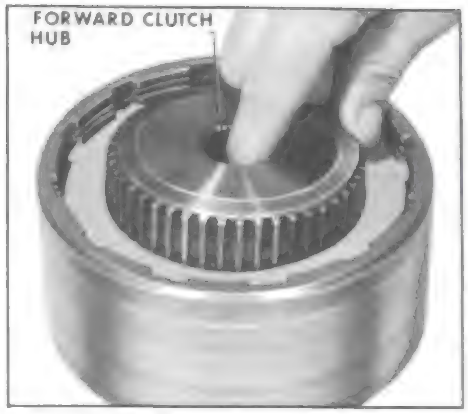


Figure 5-215

4. Lift forward clutch hub from clutch pack. See Figure 5-215.

Figure 5-216

5. Remove clutch hub front thrust washer. See Figure 5-216.

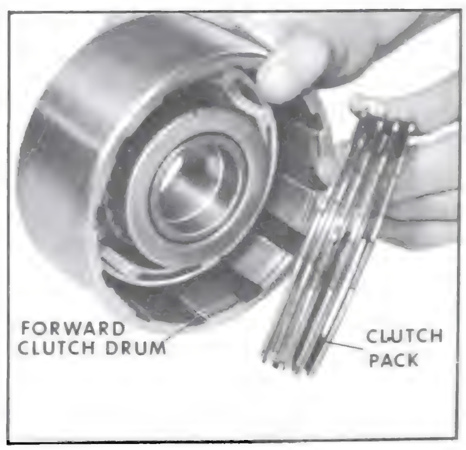


Figure 5-217

6. Remove clutch pack from forward clutch drum. See Figure 5-217.

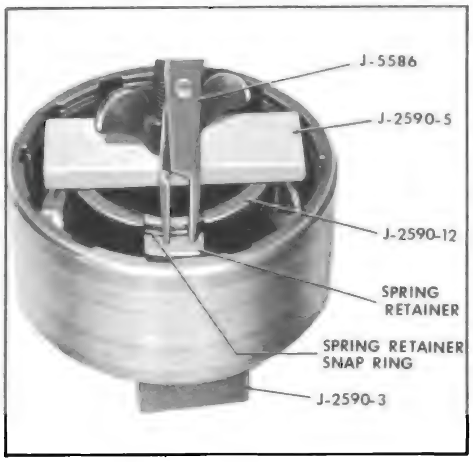


Figure 5-218

7. Using tools J-2590-3, J-2590-5, and J-2590-12 compress spring retainer. Remove snap ring. Then remove tool J-2590 and component parts, being careful that spring retainer does not catch in snap ring groove. See Figure 5-218.

NOTE: Place a piece of hard board between tool J-2590-3 and surface of forward clutch hub.

Figure 5-220

8. Lift off spring retainer and twenty-four (24) clutch springs. See Figure 5-220.

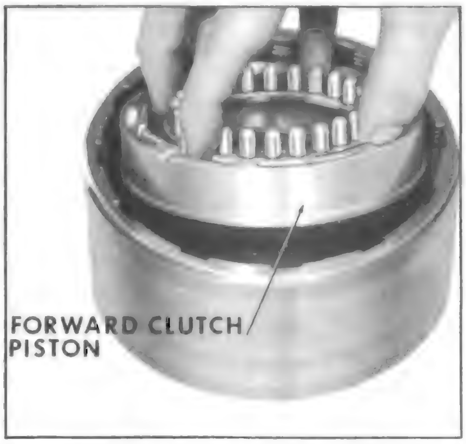


Figure 5-221

9. Lift up on forward clutch piston with a twisting motion and remove. See Figure 5-221.

Figure 5-222

10. Examine forward clutch piston outer seal. If nicked, torn or worn, remove seal. See Fig- 5-222.

Figure 5-223

11. Examine forward clutch piston inner seal. If nicked, torn or worn, remove seal. See Figure 5-223.

Figure 5-224

12. Check forward clutch drum bushing for nicks, severe scoring or wear. If bushing replacement is necessary proceed as follows: Using tool J-21424-5, press damaged bushing from forward clutch drum. See Figure 5-224.

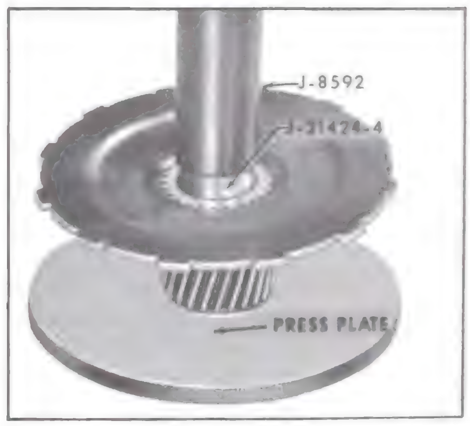


Figure 5-225

13. Check low sun gear and flange assembly bushing for nicks, severe scoring, or wear. If bushing replacement is necessary proceed as follows: Support low sun gear assembly on press plate using Tool J-21424-4 and Drive Handle J-8092 press out bushing. See Figure 5-225.

b. Inspection

1. Wash all parts in a suitable cleaning solvent. Use compressed air to dry.

2. Check steel ball in the forward clutch drum. Be sure it is free to move in hole and that orifice leading to front of clutch drum is open.

3. Check clutch plates for wear or scoring.

c. Reassembly

Figure 5-226

1. Install J-21424-5 in front of forward clutch drum. Using Drive Handle J-8092 press bushing into bore until tool J-21424-5 bottoms on hub. See Figure 5-226.

Figure 5-227

2. Install tool J-21424-4 into low sun gear. Using Drive Handle J-8092 press bushing into low sun gear until bushing installer is flush with top of low sun gear. See Figure 5-227.

Figure 5-228

3. Lubricate with transmission oil and install new forward clutch piston inner seal with seal lip pointing downward. See Figure 5-228.

NOTE: Run hand around seal after it is installed to see if seal is fully in groove.

Figure 5-230

4. Lubricate with transmission oil and install new forward clutch piston outer seal in clutch piston. Seal lip must point down. See Figure 5-230.

5. Install forward clutch piston into clutch drum using a loop of

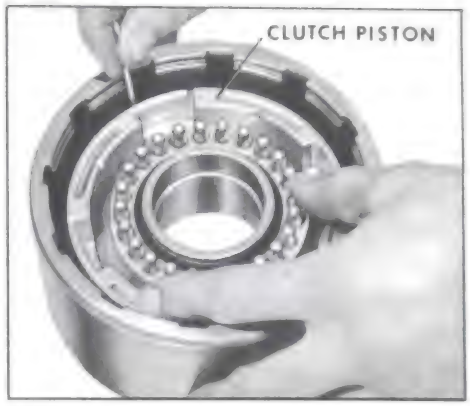


Figure 5-231

smooth wire to start lip of seal into bore. Piston should turn freely. See Figure 5-231.

NOTE: A satisfactory tool can be made by crimping a loop of .020" music wire in a short length of copper tubing.

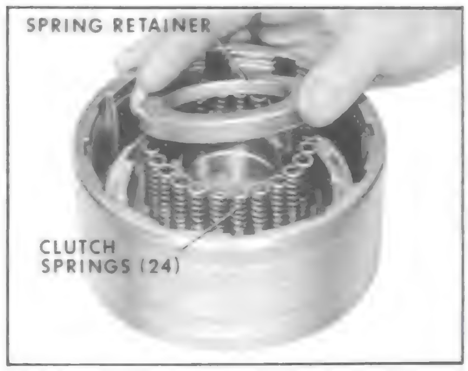


Figure 5-232

6. Carefully reassemble return springs, retainer and snap ring. See Figure 5-232.

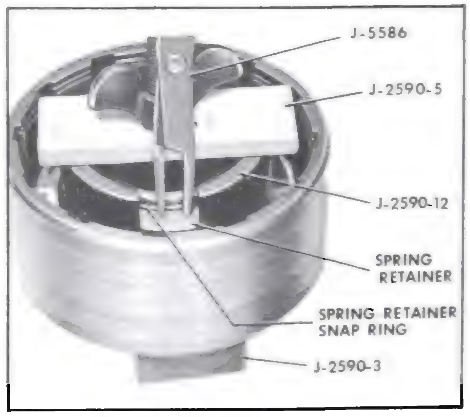


Figure 5-233

7. With spring retainer in place compress spring retainer with tools J-2590-3, J-2590-12 and J-2590-5 far enough so the spring retainer snap ring can be installed. Make sure retainer doesn't catch in snap ring groove when compressing springs. See Figure 5-233.

NOTE: Place a piece of hard board between tool J-2590-3 and forward clutch drum.

Figure 5-234

8. Install clutch hub front thrust washer to clutch hub (retain with grease) aligning tangs in clutch hub with grooves in thrust washer. Install clutch hub. See Figure 5-234.

Figure 5-235

9. Align notches on steel driven plates. Install steel driven plates and lined drive plates alternately, beginning with a steel driven plate. See Figure 5-235.

NOTE: Cars equipped with V-6 engines have 4 drive plates and 5 driven plates. Cars equipped with V-8 engines have 5 drive plates and 6 driven plates.

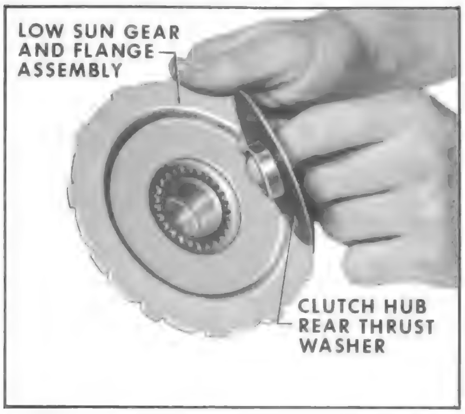


Figure 5-236

10. Install clutch hub rear thrust washer with its flange toward low sun gear and flange assembly. See Figure 5-236.

Figure 5-237

11. Install low sun gear and flange assembly. See Figure 5-237.

12. Install low sun gear and flange assembly retaining ring.

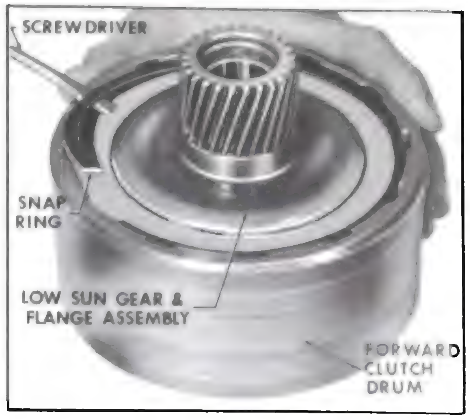


Figure 5-238

Position snap ring so gap is centered between slots in drum. See Figure 5-238.

5-20 SPEEDO DRIVEN GEAR DISASSEMBLY, AND REASSEMBLY

NOTE: Transmission need not be removed from the car to perform the following operations. Paragraph 5-20 and 5-21.

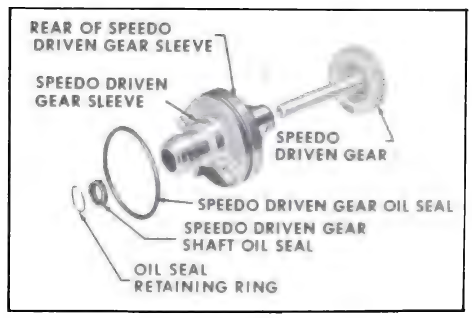


Figure 5-240

a. Disassembly

1. Remove speedo driven gear. See Figure 5-240.

2. Examine speedo driven gear oil seal. If nicked, torn or worn remove seal. See Figure 5-240.

3. Examine speedo driven gear shaft oil seal. If nicked, torn or worn remove seal.

b. Reassembly

1. Install speedo driven gear shaft oil seal with lip of seal pointing toward rear of speedo gear sleeve. Install oil seal retaining ring.

2. Install speedo driven gear oil seal. See Figure 5-240.

3. Install speedo driven gear.

5-21 DISASSEMBLY, INSPECTION AND REASSEMBLY OF GOVERNOR

a. Disassembly

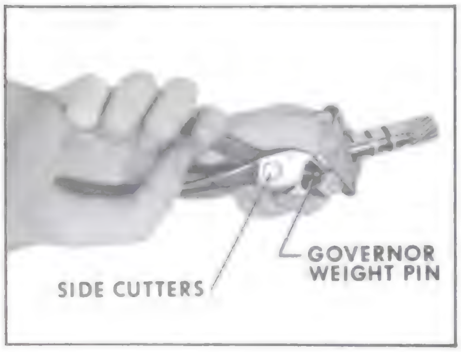


Figure 5-241

1. With side cutters remove governor weight pins. See Figure 5-241.

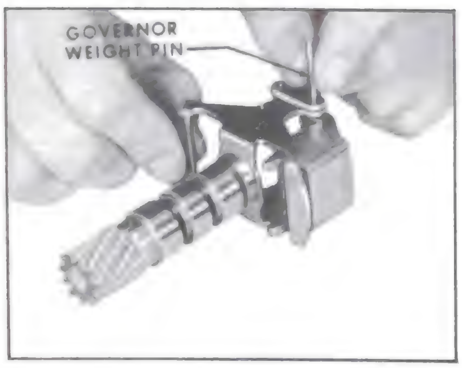


Figure 5-242

2. Remove governor weight pins. See Figure 5-242.

Figure 5-243

3. Remove governor thrust cap. See Figure 5-243.

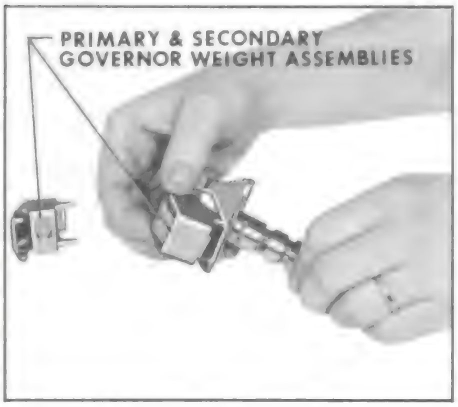


Figure 5-244

4. Remove both sets of primary and secondary governor weight assemblies. Separate primary and secondary weights, governor weight spring will fall free. See Figure 5-244.

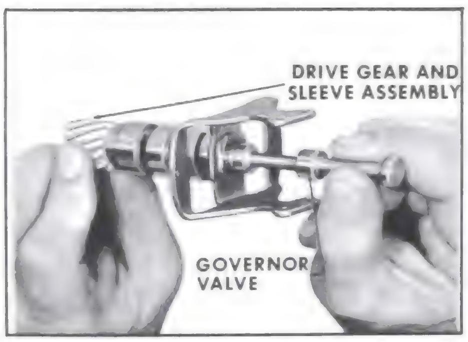


Figure 5-245

5. Remove governor valve from drive gear and sleeve assembly. See Figure 5-245.

b. Inspection

1. Clean all parts in a suitable cleaning solvent.

2. Inspect governor valve for nicks or burrs.

c. Reassembly

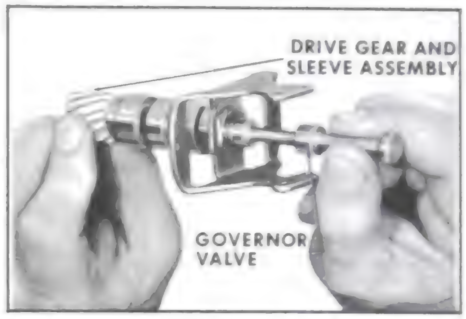


Figure 5-246

1. Install governor valve into drive gear and sleeve assembly. See Figure 5-246.

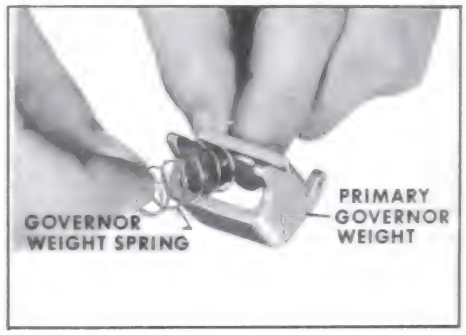


Figure 5-247

2. Install governor weight spring into primary governor weight. See Figure 5-247.

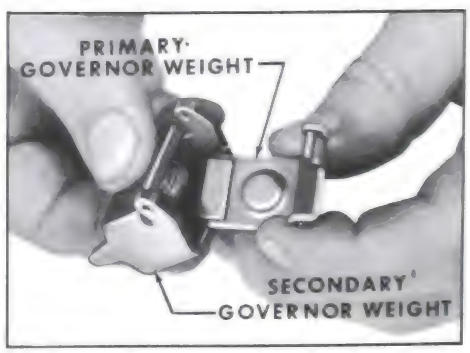


Figure 5-248

3. Retaining governor weight spring in primary governor weight with finger insert secondary governor weight. Repeat Steps 2 and 3 for other governor weight. See Figure 5-248.

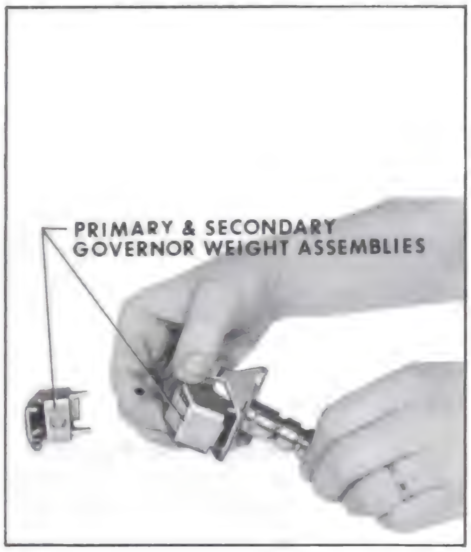


Figure 5-250

4. Install primary and secondary governor weights into drive gear and sleeve assembly. See Figure 5-250.

Figure 5-251

5. Install governor thrust cap. See Figure 5-251.

6. Install governor weight pins. See Figure 5-252.

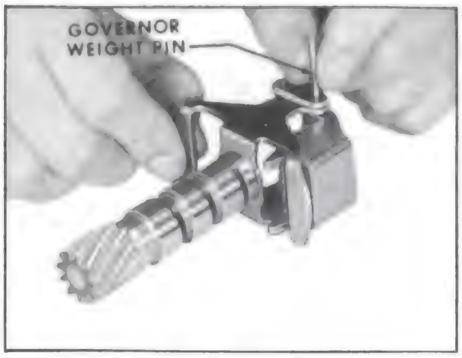


Figure 5-252

7. Install NEW governor weight pins. Crimp end of pins in a vise. See Figure 5-253.

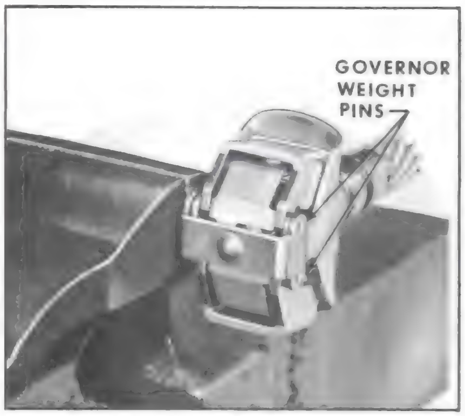


Figure 5-253

5-22 PLANET CARRIER DISASSEMBLY INSPECTION, AND ASSEMBLY

a. Disassembly

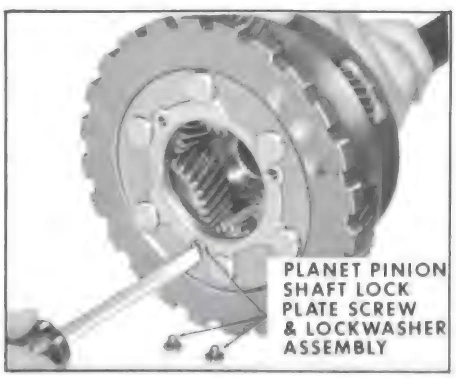


Figure 5-255

1. Remove three (3) planet pinion shaft lock plate screw and lock washers. See Figure 5-255.

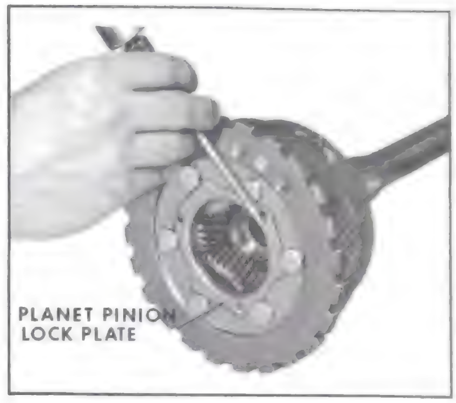


Figure 5-256

2. Rotate planet pinion lock plate and remove. See Figure 5-256.

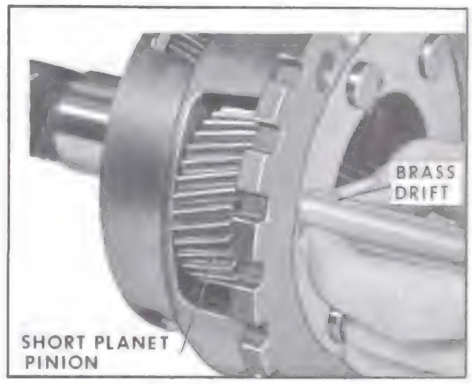


Figure 5-257

3. Start with the short planet pinion first. Insert Brass Drift into front of carrier. See Figure 5-257.

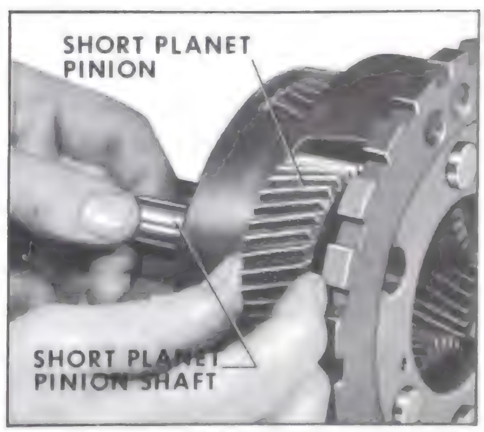


Figure 5-258

4. Remove pinion shaft and pinion gear from planet carrier. See Figure 5-528.

NOTE: Remove the other two (2) short planet pinion gears in same manner as described in Steps 4 and 5.

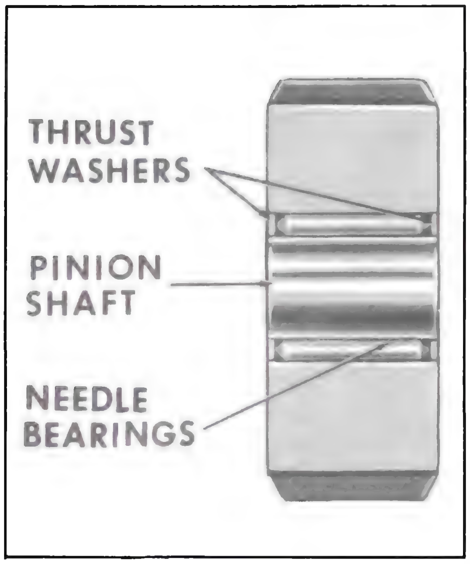


Figure 5-260

5. Remove needle bearings, and thrust washers (2) from the short planet pinion gear. See Figure 5-260.

Figure 5-261

6. Remove low sun gear needle thrust bearing. See Figure 5-261.

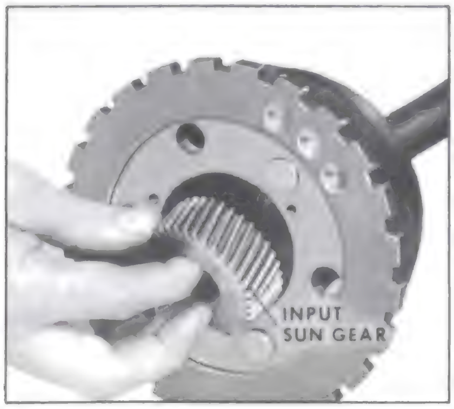


Figure 5-262

7. Remove input sun gear. See Figure 5-262.

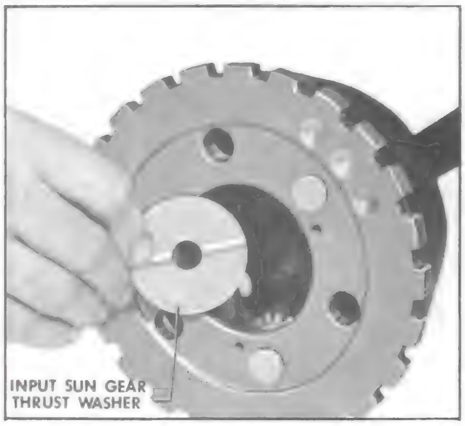


Figure 5-263

8. Remove input sun gear thrust washer. See Figure 5-263.

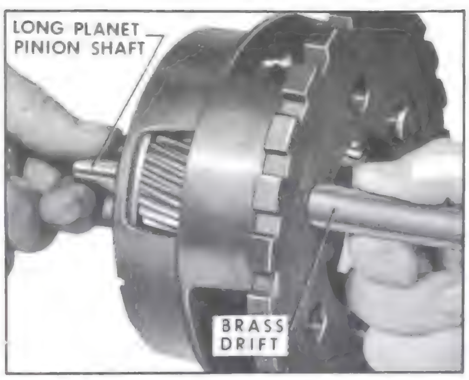


Figure 5-264

9. Insert Brass Drift through long planet pinion. Remove the long planet pinion shaft. See Figure 5-264.

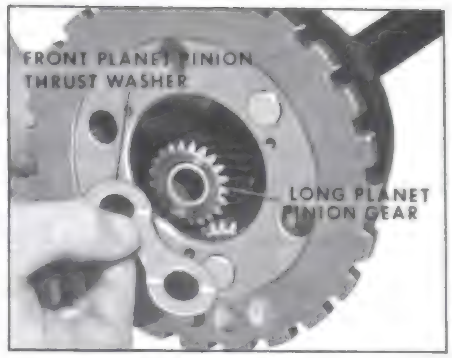


Figure 5-265

10. Remove front planet pinion thrust washer and long planet pinion gear. See Figure 5-265.

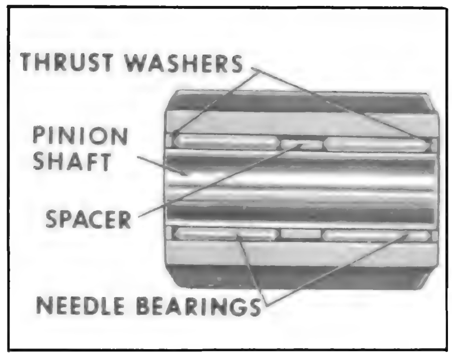


Figure 5-266

11. Remove needle bearings, spacer and two (2) thrust washers from the long planet pinion gear. See Figure 5-266.

Figure 5-267

12. Remove rear planet pinion thrust washer. See Figure 5-267.

13. Check output shaft bushing for nicks, severe scoring or wear. If bushing replacement is necessary

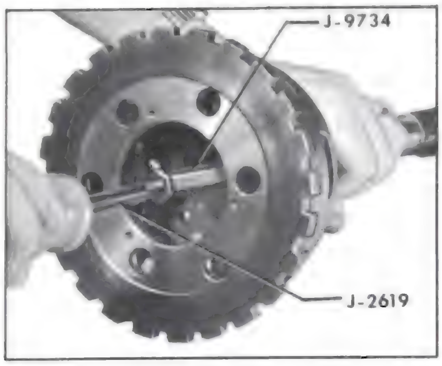


Figure 5-268

continue as follows: Install Bushing Remover J-9534 into bushing. Install Slide Hammer J-2619 into J-9534, using slide hammer remove bushing from planet carrier. See Figure 5-268.

b. Inspection of Planet Carrier Parts

1. Wash all parts in a cleaning solvent Air dry all parts.

2. Check the planet pinion gears and input sun gear tooth damage.

3. Check the planet pinion thrust washers and input sun gear thrust washer.

4. Check planet pinion needle bearings. If bearings show excessive wear, all the needle bearings must be replaced.

5. Check the planet pinion shafts closely, if worn replace the worn shafts.

6. Check the output shaft bushing, if worn replace.

c. Reassembly

1. Using tool J-21424-3 and J-8592 press the new bushing in until J-21424-3 touches the machined surface of the planet carrier assembly. See Figure 5-270.

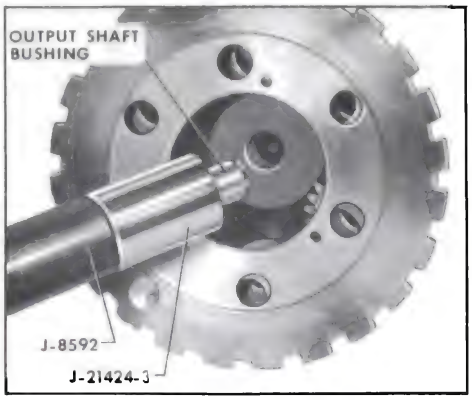


Figure 5-270

2. Install the long planet pinion gears first. Install the rear planet pinion thrust washer. Oil groove must be toward pinion gear. See Figure 5-271.

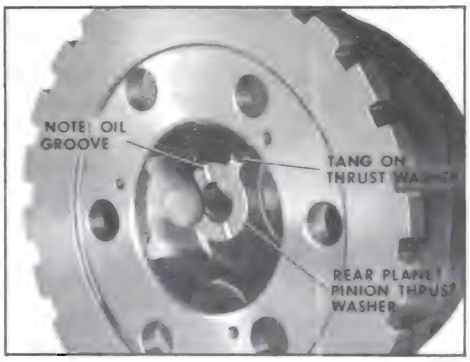


Figure 5-271

3. Install front planet pinion thrust washer. Retain thrust washer to case with grease. Oil grooves on the thrust washer must be toward the pinion gears. See Figure 5-272.

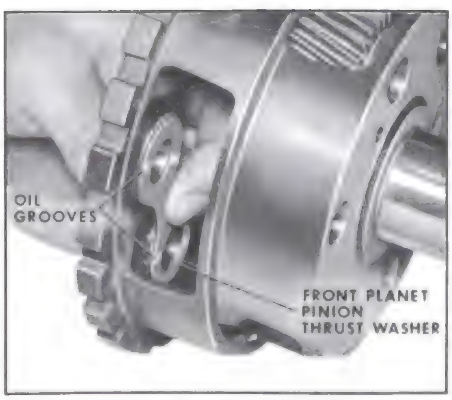


Figure 5-272

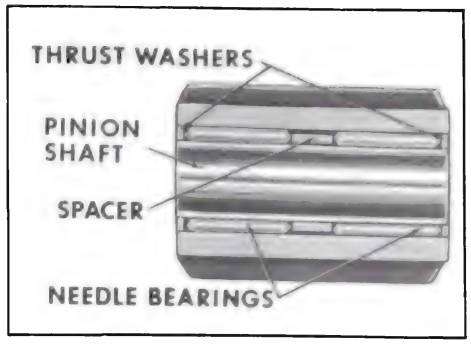


Figure 5-273

4. Coat inside pinion gear with petrolatum. Install Pinion Shaft J-21423 into long planet pinion gear. Install twenty (20) needle bearings, spacer, twenty more needle rollers, and two (2) thrust washers. See Figure 5-273. Carefully remove pinion shaft. With a twisting motion lock both sets of needle rollers in place. See Figure 5-273A.

Figure 5-273-A

5. Position the long planet pinion assembly with the thrust washers at each end, in the planet carrier. Install the pinion shaft from the front of the carrier. As the shaft is being pushed in, make certain that it picks up the thrust washer. Turn the pinion shaft so the groove faces the center of the planet carrier. See Figure 5-274.

NOTE: Install the other two (2) long planet pinion gears as described in Steps 2-3-4-5.

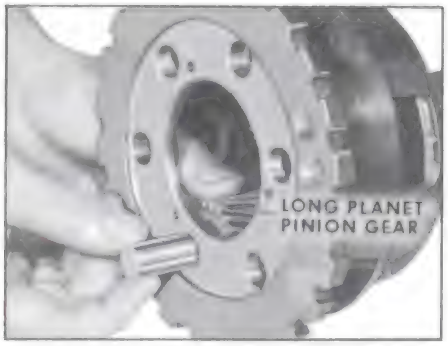


Figure 5-274

6. Install the input sun gear thrust washer with the oil groove facing input sun gear. See Figure 5-275.

Figure 5-275

7. Install input sun gear into planet carrier. See Figure 5-276.

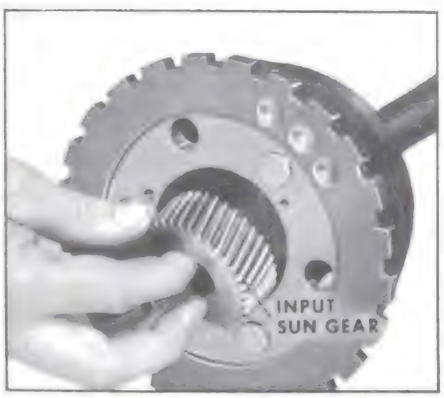


Figure 5-276

8. Install low sun gear needle thrust bearing. See Figure 5-277.

Figure 5-277

9. Install the rear planet pinion thrust washer. Oil groove must be toward pinion gear. See Figure 5-278.

NOTE: The front thrust washer already installed with the long planet pinions also is used for the short planet pinions as the two (2) pinions are paired together on one set of thrust washers.

Figure 5-278

10. Install twenty (20) needle bearings, and one thrust washer in the pinion gear. See Figure 5-280. With a twisting motion, lock the needle rollers in place. See Figure 5-280A.

11. Position short planet pinion assembly and thrust washers at each end of the planet carrier. Install pinion shaft from the front of planet carrier. As the pinion shaft is being pushed in, make certain that it picks up the thrust washers. Turn the pinion shaft so the groove faces center of planet carrier. See Figure 5-281.

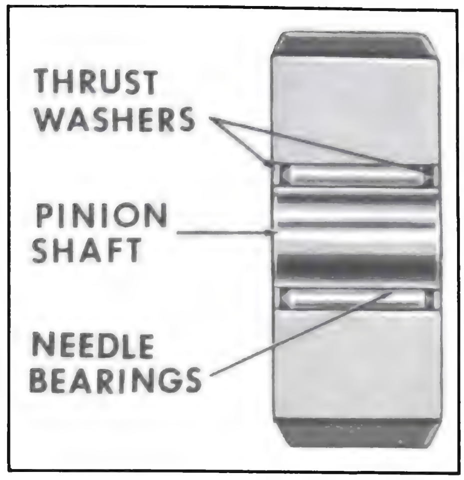


Figure 5-280

Figure 5-280A

12. Install planet pinion lock plate. Rotate plate so extended portions align with slots in planet pinion shafts, and three (3) attaching screw holes. See Figure 5-282.

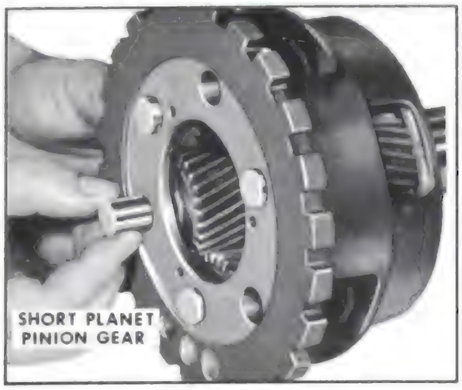


Figure 5-281

13. Install three (3) planet pinion shaft lock plate screw and lock washers. See Figure 5-283.

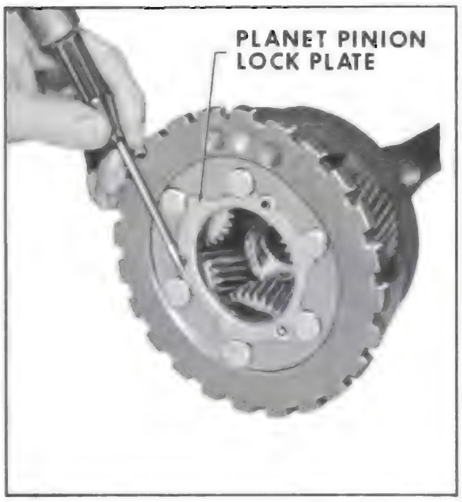


Figure 5-282

5-23 ASSEMBLY OF TRANSMISSION FROM MAJOR PARTS AND UNITS

a. General Instructions

1. Before starting to assemble the transmission make certain that all parts are absolutely clean. Keep hands and tools clean to avoid getting dirt into assembly. If work is stopped before assembly is completed cover all openings with clean cloths.

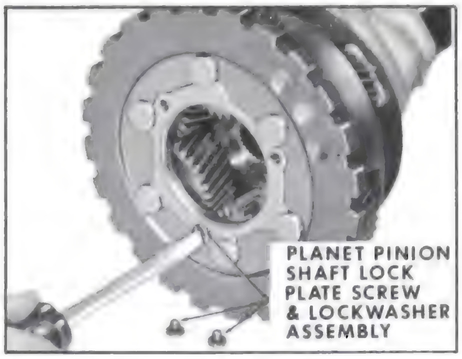


Figure 5-283

2. All moving parts should be given a light coating of transmission oil before installation. Thrust washers may be held in place with petroleum jelly, sparingly applied.

3. Do not take a chance on used gaskets and seals - use new ones to avoid oil leaks.

4. Use care to avoid making nicks or burrs on parts, particularly at bearing surfaces and surfaces where gaskets are used.

5. It is extremely important to tighten all parts evenly and in proper sequence, to avoid distortion of parts and leakage at gaskets and other joints. Use a reliable torque wrench to tighten all bolts and nuts to specified toruqe and in the specified sequence.

1. Install case bushing, make certain split on bushing is opposite notch in case. See Figure 5-284.

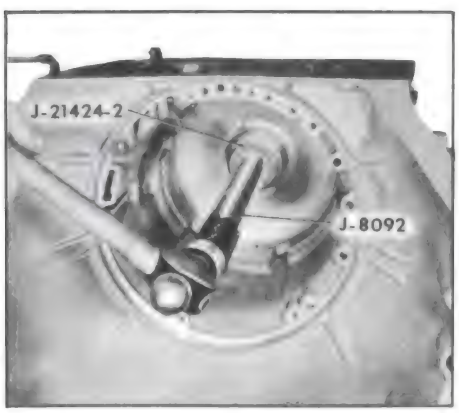


Figure 5-284

b. Installation of Range Selector Lever, Shaft and Parking Lock Actuator

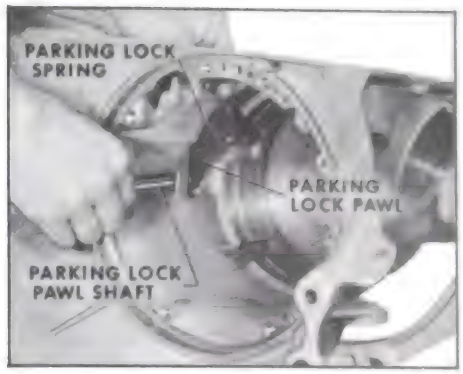


Figure 5-285

2. Retain parking lock pawl and spring in case with parking lock pawl shaft. See Figure 5-285.

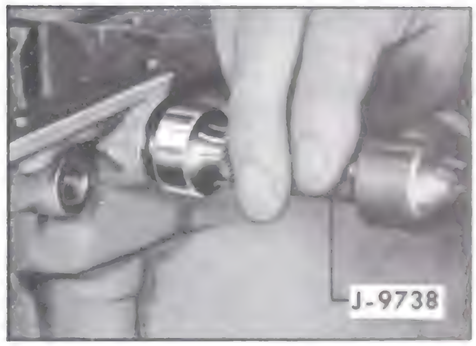


Figure 5-286

NOTE: Make certain parking pawl shaft is bottomed in its bore in case.

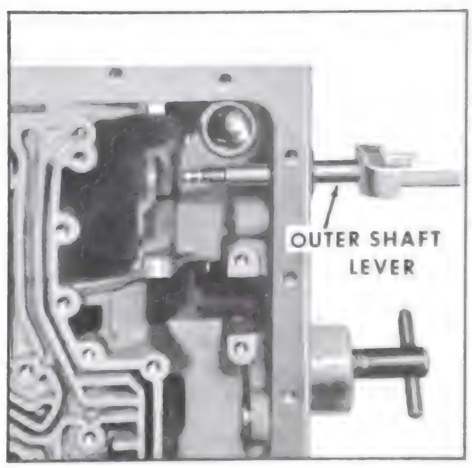


Figure 5-287

3. Install outer shift lever seal using J-9738. Make certain lip of seal points toward center of case. See Figure 5-286.

4. With a twisting motion insert outer range selector lever into case. See Figure 5-287.

5. Assemble park lock actuator assembly to inner park lock and range selector. See Figure 5-288.

Figure 5-288

6. Install inner park lock and range selector assembly to outer range selector lever. Install nut on range selector lever. See Figure 5-290.

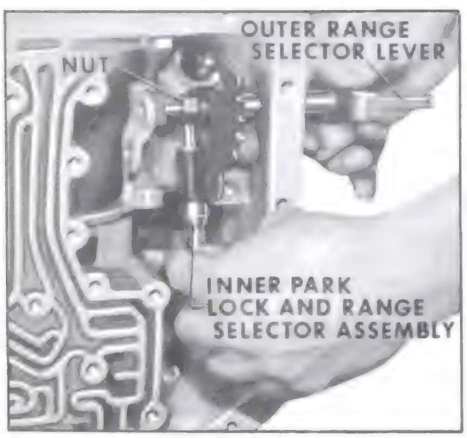


Figure 5-290

NOTE: Make certain longest end on range selector lever is to the bottom of transmission.

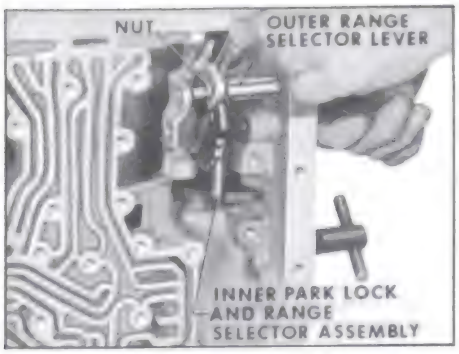


Figure 5-291

7. Slide outer range selector lever into case and tighten nut using a 9/16" wrench. See Figure 5-291.

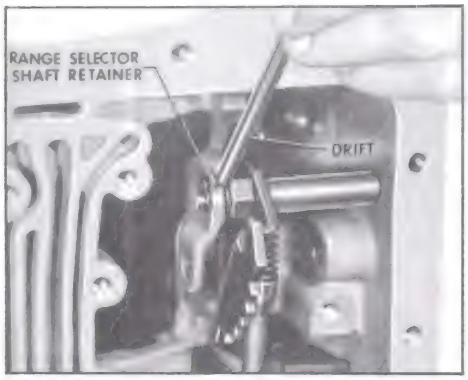


Figure 5-292

8. Install range selector shaft retainer. See Figure 5-292.

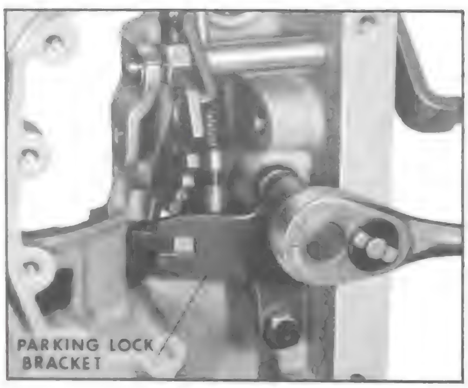


Figure 5-293

9. Install parking bracket to transmission case. Torque bolts to 8-12 ft. lbs. torque. See Figure 5-293.

c. Installing Reverse Clutch

Figure 5-294

1. Lubricate with transmission oil and install reverse clutch piston outer seal. See Figure 5-294.

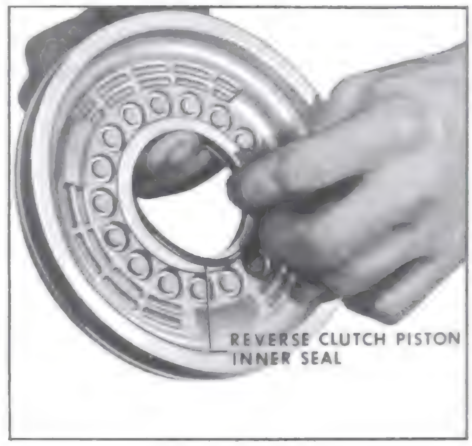


Figure 5-295

2. Lubricate with transmission oil and install reverse clutch piston inner seal. See Figure 5-295.

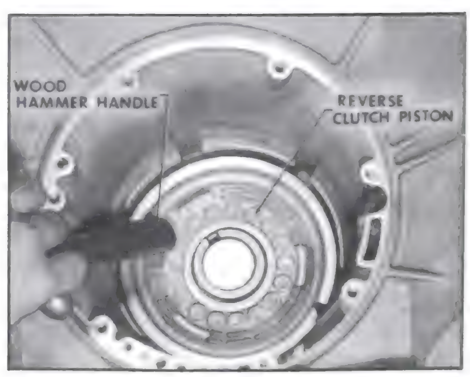


Figure 5-296

3. With transmission in vertical position install the reverse clutch piston into case. Tap piston with hammer handle to make certain piston is seated in case. See Figure 5-296.

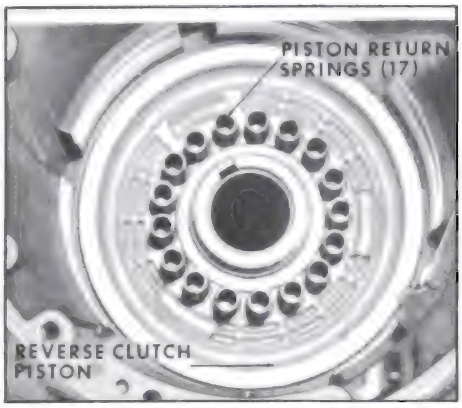


Figure 5-297

4. Install seventeen (17) clutch piston return springs. See Figure 5-297.

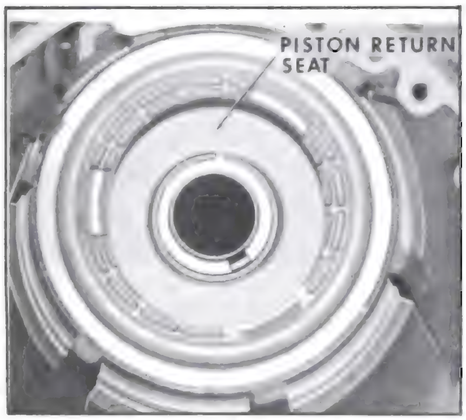


Figure 5-298

5. Position piston return seat on piston return springs. Place snap ring on return seat so that ring may be easily installed when seat is compressed with tool. See Figure 5-298.

6. Using J-21420-1 and J-21420-2 compress piston return seat so snap ring may be installed with J-5586 Pliers. See Figure 5-300.

CAUTION: Make certain inner edge of seat does not hang up on snap ring groove while being compressed.

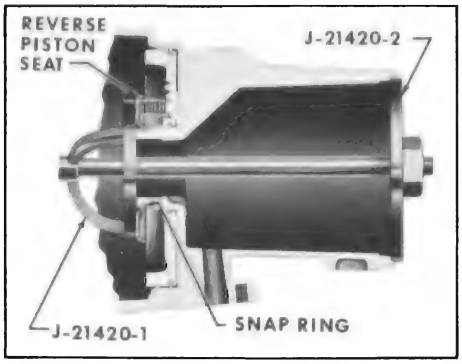


Figure 5-300

7. Install reverse clutch cushion spring. Install the cushion spring with the dish down. See Figure 5-301.

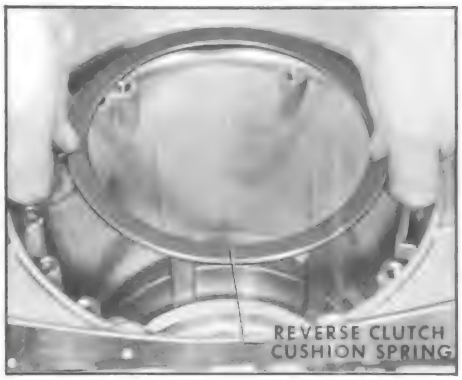


Figure 5-301

8. Align notches on the steel driven plates. Install the steel driven plates and lined drive plates alternately, beginning with

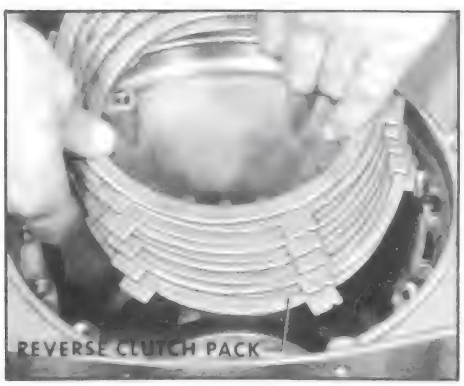


Figure 5-302

a steel driven plate. The notched lug on each driven plate goes in the 5 o'clock groove in case. See Figure 5-302.

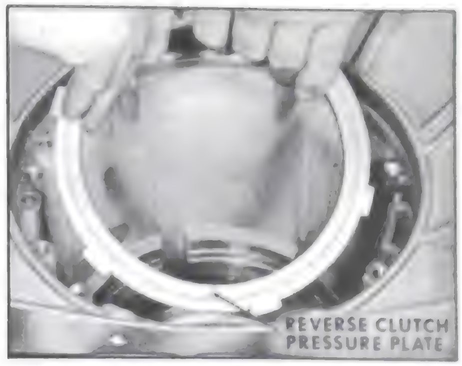


Figure 5-303

CAUTION: Steel plates are waved and should all face same direction. For this reason notches are provided to indicate correct installation.

NOTE: Cars equipped with V-6 engines have 5 driven and 4 drive clutch plates. Cars equipped with V-8 engine have 6 driven and 5 drive clutch plates.

9. Install reverse clutch pressure plate with the identification mark being installed in the 5 o'clock groove in case. See Figure 5-303.

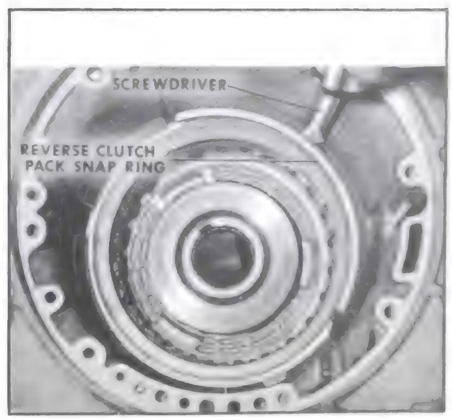


Figure 5-304

10. Install reverse clutch pack snap ring. See Figure 5-304.

11. Insert feeler gauge between any reaction plate and adjacent

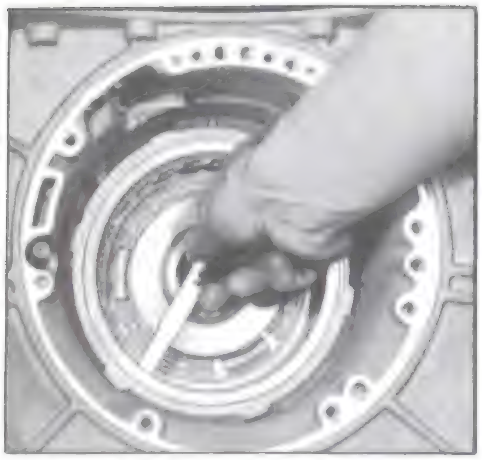


Figure 5-305

faced plate. See Figure 5-305. Clearance for the reaction plates are shown below:

Three selective plates are released for service. These plates are identified with one, two or three identification marks. Plates are graduated in size with one identification mark being the smallest. The clearance should be .020" - .058".

d. Installing Planetary Gear Set

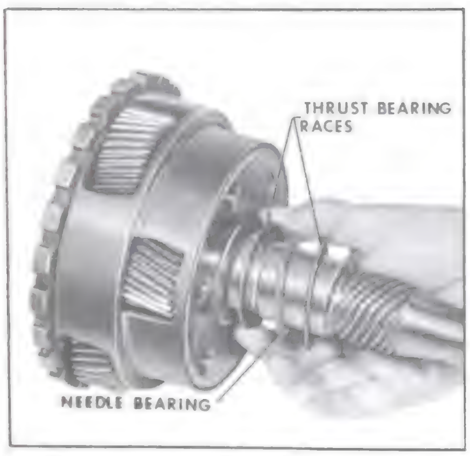


Figure 5-306

1. Install thrust bearing race with a lip, needle bearing, and a second plain thrust bearing race to the rear face of the planetary gear set. Retain with grease. See Figure 5-306.

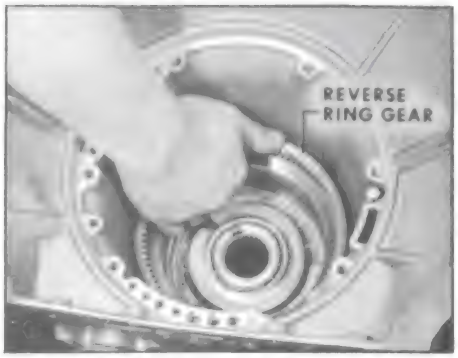


Figure 5-307

2. Install reverse ring gear into case. Rock and turn ring gear to pick up clutch plate splines. See Figure 5-307.

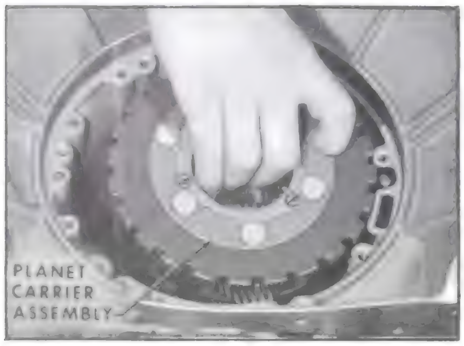


Figure 5-308

3. Install planetary gear set into case. See Figure 5-308.

5-24 INSTALLATION OF LOW SERVO ASSEMBLY, LOW BAND, AND FORWARD CLUTCH

a. Installation of Low Servo

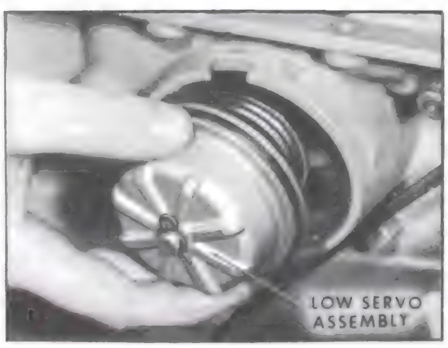


Figure 5-310

1. Install low servo piston assembly into case. See Figure 5-310.

Figure 5-311

2. Install low servo cover oil seal. See Figure 5-311.

Figure 5-312

3. Install low servo cover to case. See Figure 5-312.

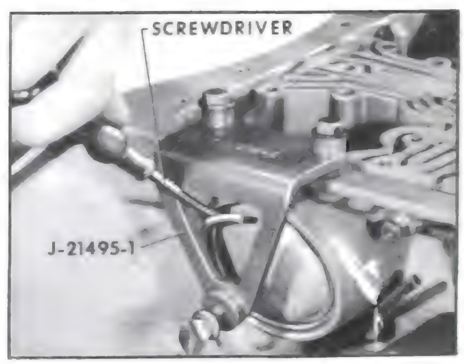


Figure 5-313

4. Compress low servo cover with J-21495-1 and install retaining snap ring. See Figure 5-313.

b. Installation of Low Band

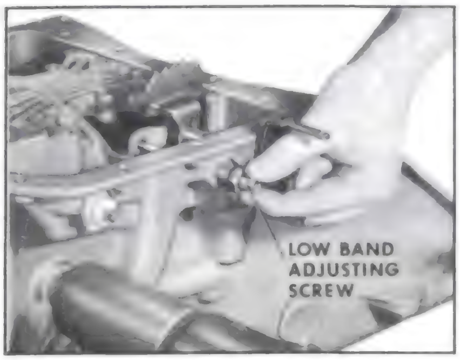


Figure 5-314

1. With transmission in vertical position install band adjusting screw into case. See Figure 5-314.

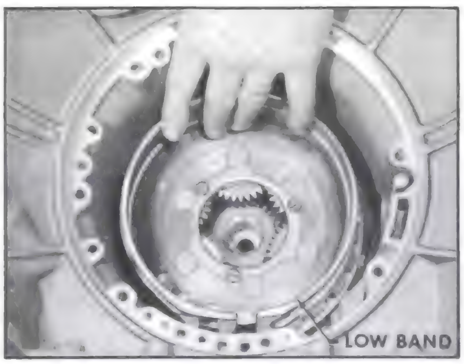


Figure 5-315

2. Install low band into case. See Figure 5-315.

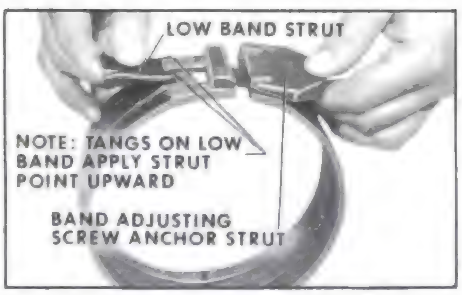


Figure 5-316

3. This picture is for illustration purposes only. It shows the proper positioning of the low band apply strut and band adjusting screw anchor strut. See Figure 5-316.

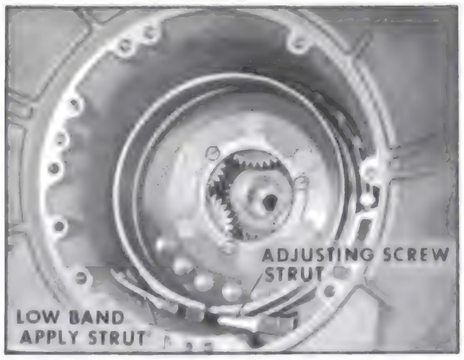


Figure 5-317

4. Install low band apply strut and band adjusting screw strut. After both struts have been installed, tighten low band adjusting screw enough to prevent struts from falling out. See Figure 5-317.

c. Installing the Forward Clutch Assembly

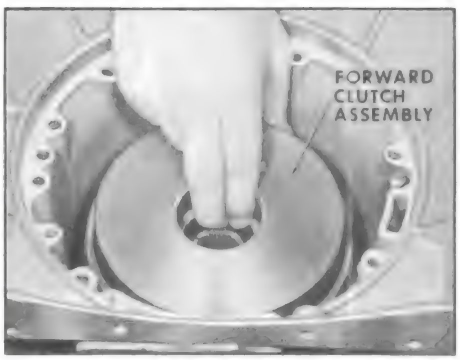


Figure 5-318

1. Install forward clutch assembly turning slightly to engage low sun gear with planet pinions. See Figure 5-318.

d. Check Forward Clutch to Oil Pump Clearance

1. Attach slide hammer bolt to threaded hole in oil pump. With flat of hand pump on end of input shaft so all parts are clear back. Install dial indicator set on rod and "O" dial indicator on end of input shaft. Push on end of output shaft to move everything forward, the reading obtained will be the

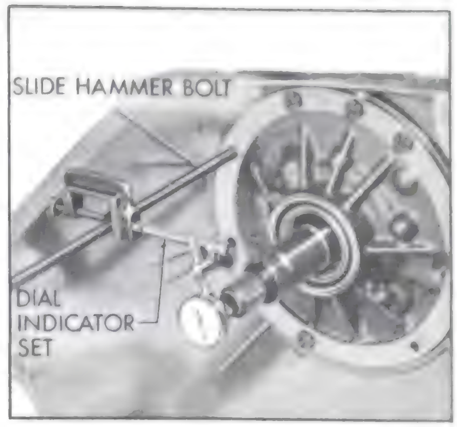


Figure 5-320

clearance. There are three selective thrust washers available, .099/.095, .081/.077 and .063/.059. Select and washer so the clearance will be between .008" and .051".

Figure 5-321

2. Grease and install selective fit washer to pump cover hub. See Figure 5-321.

Figure 5-322

3. Install two (2) pump cover to clutch drum oil sealing rings. See Figure 5-322.

5-25 INSTALLATION OF OIL PUMP GUIDE PIN, GASKET AND OIL PUMP ASSEMBLY

Figure 5-323

1. Install oil pump to case seal. See Figure 5-323.

Figure 5-324

2. Install new pump gasket and guide pins. See Figure 5-324.

Figure 5-325 .

3. Install input shaft oil rings. See Figure 5-325.

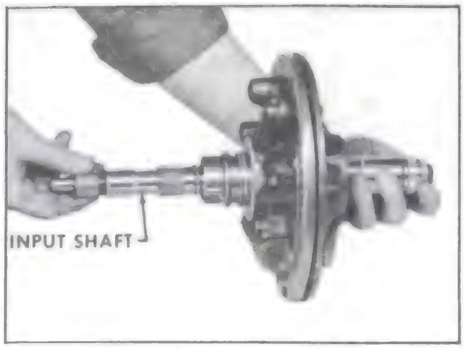


Figure 5-326

4. Coat input shaft oil rings with oil and install into oil pump. Then install pump into case. Apply a thin coat of oil around edge of pump. See Figure 5-326.

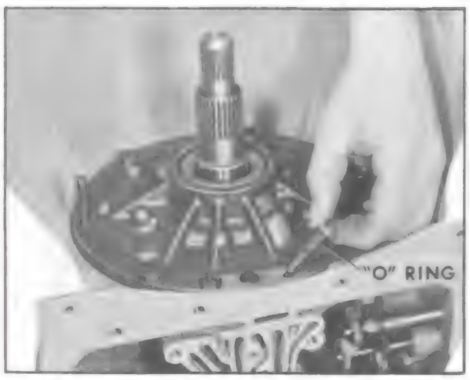


Figure 5-327

5. Remove guide pins and install eight (8) retaining bolts (with new O-rings under head). See Figure 5-327.

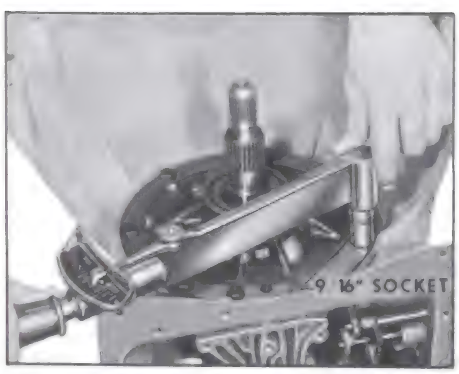


Figure 5-328

6. Torque the eight (8) pump retaining bolts to 16-24 ft. lbs. See Figure 5-328.

5-26 LOW BAND ADJUSTMENT

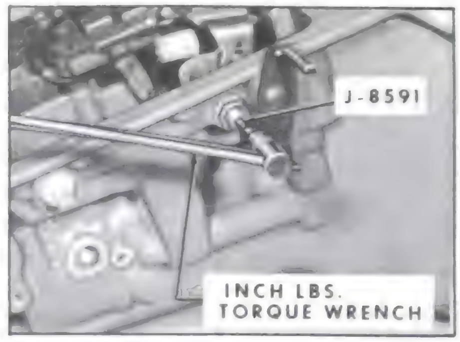


Figure 5-330

1. Adjust low band by first tightening adjusting screw to 40 in. lbs. torque. See Figure 5-330.

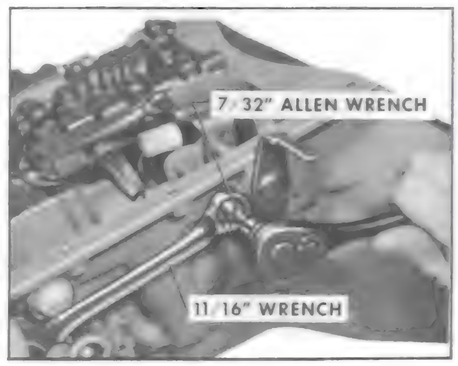


Figure 5-331

2. Back off band adjusting screw four (4) turns and lock nut. See Figure 5-331.

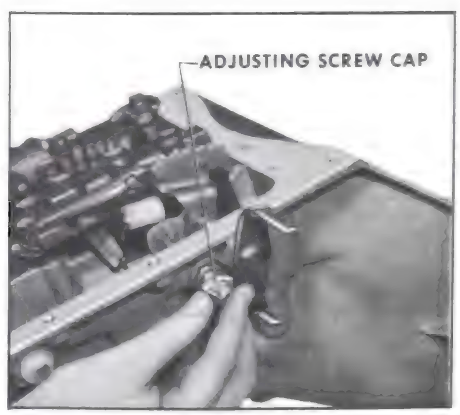


Figure 5-332

3. Install adjusting screw. cap. See Figure 5-332.

5-27 INSTALLATION OF SPEEDOMETER DRIVING GEAR

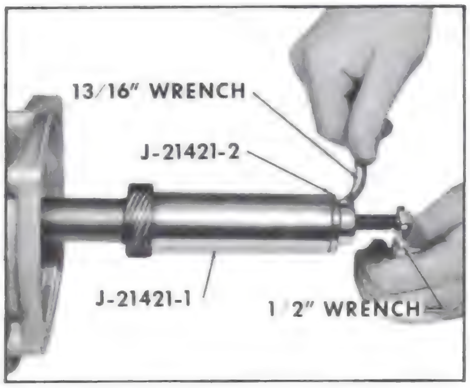


Figure 5-333

1. With transmission in a horizontal position install speedometer driving gear. Place transmission in Park range. Using tools J-21421-1 and J-21421-2 drive speedometer driving worm gear onto output shaft. Drive gear on until J-21421-2 bottoms on end of output shaft. When tool bottoms speedometer driving gear is in proper location. See Figure 5-333.

5-28 INSTALLATION OF REAR BEARING RETAINER BUSHING, OIL SEAL, BEARING RETAINER AND SPEEDO DRIVEN GEAR

a. Installation of Rear Bearing Retainer Bushing

1. Using Drive Handle J-8392 and Installer J-21424-1 install rear bearing reatainer bushing. See Figure 5-334.

Figure 5-334

b. Installation of Output Shaft to Rear Bearing Retainer Oil Seal

Figure 5-335

1. Install output shaft to rear bearing retainer oil seal using

Figure 5-336

Installer J-21426. See Figure 5-335.

c. Installation of Rear Bearing Retainer

1. Install rear bearing retainer oil seal. See Figure 5-336.

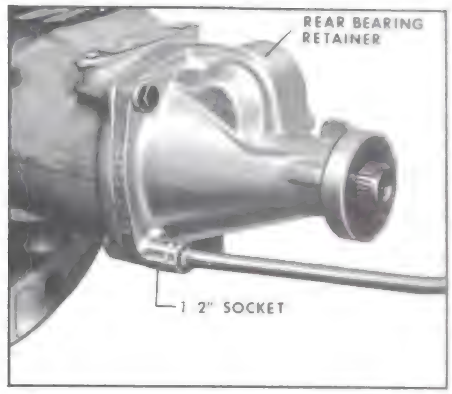


Figure 5-337.

2. Install rear bearing retainer to case and install four (4) retaining bolts, using a 9/16" socket. Torque bolts to 25-35 ft. lbs. torque. See Figure 5-337.

d. Installing Speedometer Driven Gear Assembly

Figure 5-338

1. Install speedo driven gear assembly into rear bearing retainer. See Figure 5-338.

Figure 5-339

2. Install speedometer driven gear sleeve retainer. Torque bolt to 8-12 ft. lb. torque.

5-29 INSTALLATION OF VALVE BODY

Figure 5-340

1. With transmission in horizontal position, install valve body to plate gasket. See Figure 5-340.

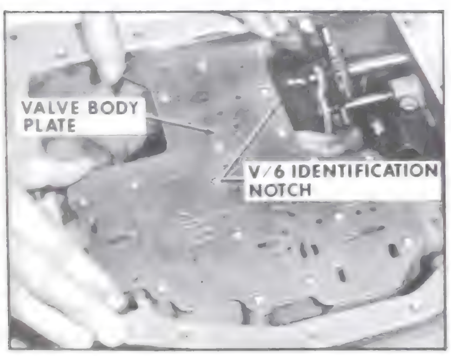


Figure 5-341

2. Install valve body plate.

NOTE: V/6 valve body plates have identification notch. See Figure 5-341.

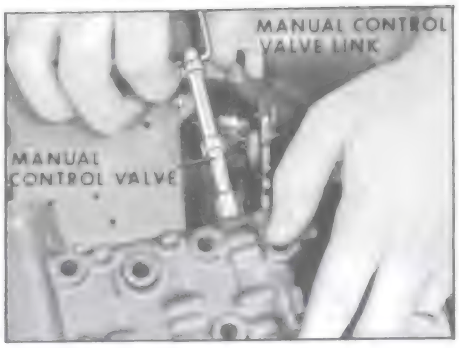


Figure 5-342

3. Install manual control valve and link into valve body assembly. See Figure 5-342.

Figure 5-343

4. Install manual control valve link into park, lock and range selector inner lever. See Figure 5-343.

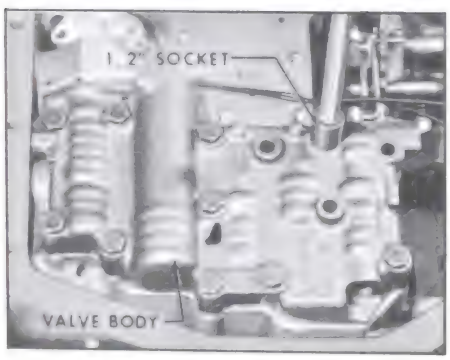


Figure 5-344

5. Install eleven (11) valve body to case retaining bolts. Torque bolts to 8-11 ft. lbs. See Figure 5-344.

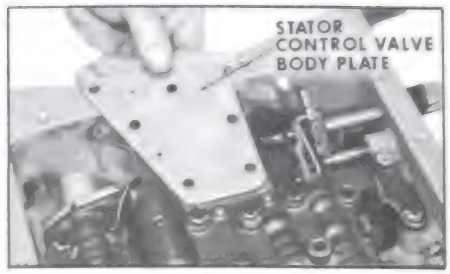


Figure 5-345

6. Install the stator control valve plate. See Figure 5-345.

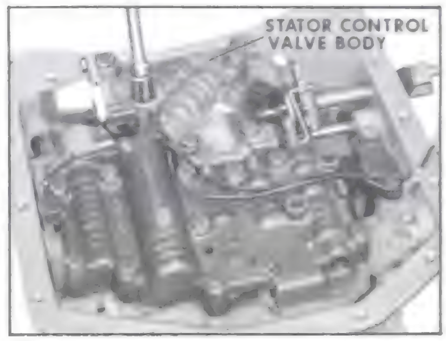


Figure 5-346

7. Install stator control valve body and seven (7) bolts retaining the stator control valve body. Torque bolts to 8-11 ft. lbs. See Figure 5-346.

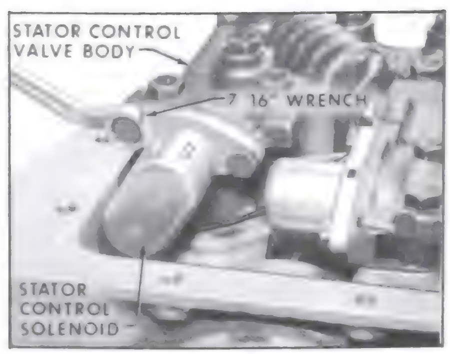


Figure 5-347

8. Install stator control solenoid and gasket to stator control valve body. Torque bolts to 8-12 ft. lbs. See Figure 5-347.

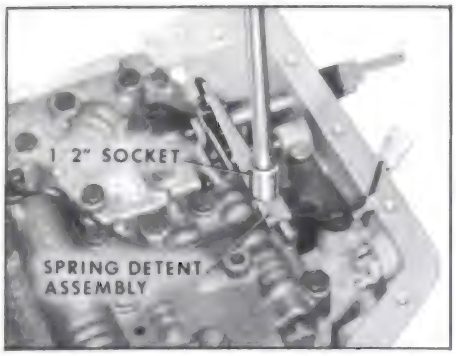


Figure 5-348

9. Before installing spring detent assembly note routing of solenoid wires. Install spring detent assembly. Torque bolt to 8-12 ft. lbs. center spring over detent plate. See Figure 5-348.

Figure 5-350

10. Install solenoid switch into case. See Figure 5-350.

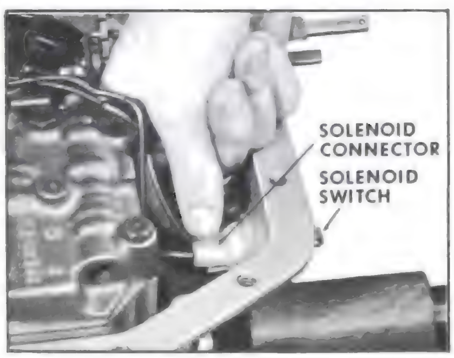


Figure 5-351

11. Install solenoid connector to solenoid switch. See Figure 5-351.

12. Install oil strainer pipe to case seal. See Figure 5-352.

Figure 5-352

13. Install strainer pipe to transmission case. See Figure 5-353.

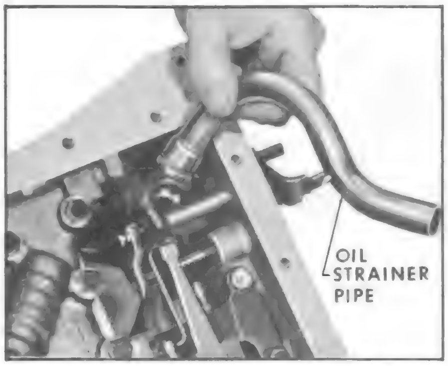


Figure 5-353

14. Install oil strainer to oil strainer pipe grommet. See Figure 5-354.

Figure 5-354

15. With a turning motion, install oil strainer to oil strainer pipe. See Figure 5-355.

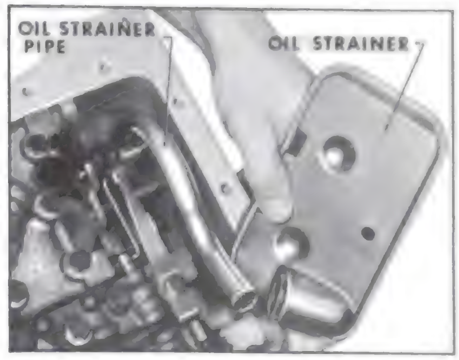


Figure 5-355

16. Torque oil strainer retaining bolt to 8-12 ft. lbs. See Figure 5-356.

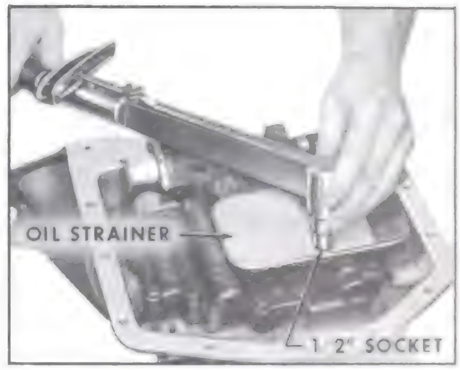


Figure 5-356

17. Install oil pan gasket and pan. See Figure 5-357.

Figure 5-357

18. Install fourteen (14) oil pan attaching bolts. Torque bolts to 10-12 ft. lbs. See Figure 5-358.

Figure 5-358

5-30 INSTALLATION OF GOVERNOR AND VACUUM MODULATOR

a. Installation of Governor

Figure 5-360

1. Slide governor into its bore in case. Turn governor assembly so teeth on governor gear engage teeth on output shaft. See Figure 5-360.

2. Install governor gasket and cover to case. Torque bolts to 8-12 ft. lbs. See Figure 5-361.

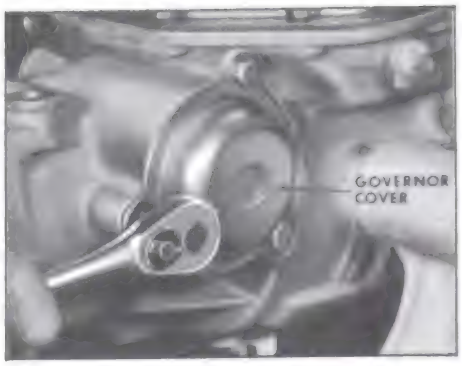


Figure 5-361

b. Installation of Vacuum Modulator

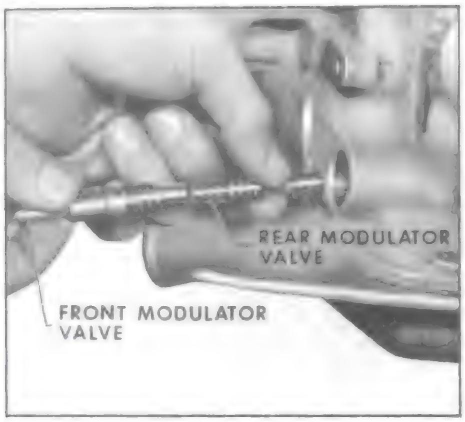


Figure 5-362

1. Slide rear modulator valve into front modulator valve then install into bore in case. See Figure 5-362.

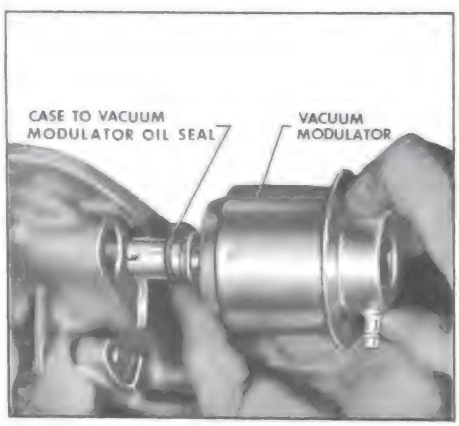


Figure 5-363

2. Install case to vacuum modulator oil seal. Install modulator into case. See Figure 5-363.

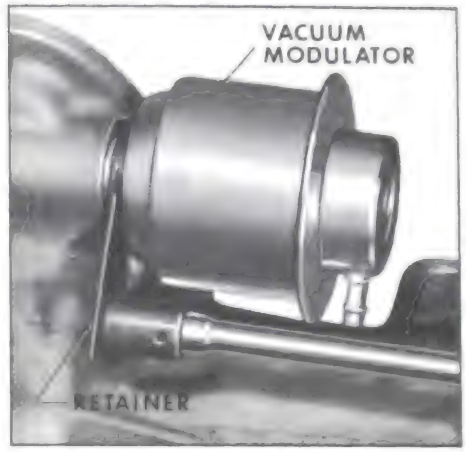


Figure 5-364

NOTE: <u>V/6 vacuum modulators have a brown daub of paint for identification. V/8 has no paint identification.</u>

3. Install vacuum modulator retainer. Install retainer so tang points toward vacuum modulator. Torque bolt to 8-12 ft. lbs. See Figure 5-364.

5-31 CHECKING CONVERTER

1. Check converter for leaks as follows:

a. Install tool J-21369 and tighten. See Figure 5-365.

Figure 5-365

b. Fill converter with air; 80 psi.

c. Submerge in water and check for leaks.

2. Check converter end clearance as follows:

a. Install tool J-21371-2 and tighten brass nut. See Figure 5-366.

Figure 5-366

b. Install tool J-21371-3 and tighten hex nut. See Figure 5-367.

Figure 5-367

c. Install dial indicator set at 0 as shown in Figure 5-368.

d. Loosen hex nut. When nut is fully loosened the reading obtained on the dial indicator will be converter end clearance. If clearance is .050" or over and the oil has the appearance of having been mixed with aluminum paint, replace the converter. See Figure 5-368.

Figure 5-368

3. Install converter. See Figure 5.369.

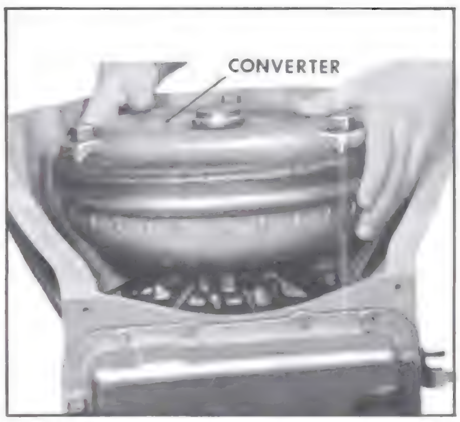


Figure 5-369

5-32 TROUBLE DIAGNOSIS GUIDE

a. No Drive in Any Selector Position; Cannot Load Engine

1. Low oil level.
2. Clogged oil strainer screen or suction pipe loose.
3. Defective pressure regulator valve.
4. Front pump defective.
5. Input shaft broken.

b. Engine Speed Flares on Standstill Starts But Acceleration Lags

1. Low oil level.
2. Clogged oil strainer screen.
3. Servo piston seal leaking.
4. Band facing worn.
5. Low band apply struts disengaged or broken.

c. Engine Speed Flares on Upshifts

1. Low oil level.
2. Improper band adjustment.
3. Clogged oil strainer screen.
4. Forward clutch partially applied.
5. Forward clutch plates worn.
6. Forward clutch piston hanging up.
7. Forward clutch drum relief ball not sealing.
8. Vacuum modulator.

d. Upshifts Harsh

1. Vacuum modulator line broken or disconnected.
2. Vacuum modulator diaphgram leaks.
3. Vacuum modulator valve stuck.

e. Closed Throttle (coast) Downshift Harsh

1. Improper low band adjustment.
2. High engine idle speed.
3. Downshift timing valve malfunction.
4. High main line pressure. Check the following:

a. Vacuum modulator line broken or disconnected.

b. Modulator diaphragm ruptured.

c. Sticking pressure regulator coast valve, pressure regulator valve or vacuum modulator valve.

f. Clutch Failure

1. Low band adjusting screw backed off more than specified.
2. Improper order of clutch plate assembly.
3. Extended operation with low oil level.
4. Forward clutch drum relief ball stuck.

g. Car Creeps Excessively in Drive

1. Idle speed too high.
2. Closed throttle stator switch improperly adjusted.

h. Car Creeps in Neutral

1. Forward clutch or low band not released.

i. No drive in Reverse

1. Reverse clutch piston stuck.
2. Reverse clutch plates worn out.
3. Reverse clutch seal leaking excessively.
4. Blocked reverse clutch apply orifice.

j. Transmission Case and Extension Oil Seal

1. Extension oil seal.
2. Outer shift lever oil seal.
3. Speedometer driven gear fitting.
4. Oil cooler pipe connections.
5. Vacuum modulator assembly and case.

k. Oil forced out of Filler Tube

1. Oil level too high, foaming caused by planet carrier running in oil.
2. Water in oil.
3. Leak in pump suction circuits.

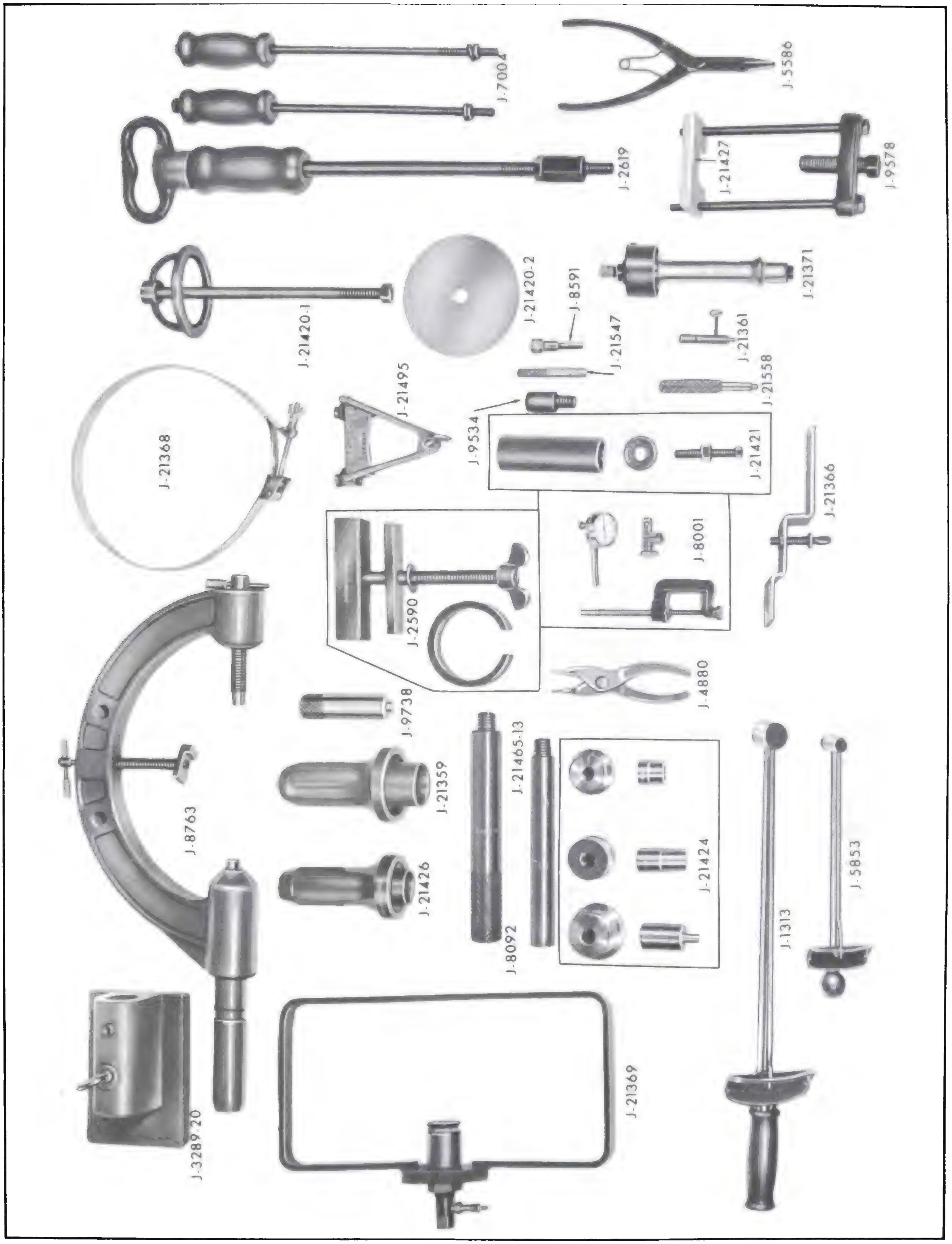


Figure 5-370—Special Tools

J-3289-20	-	HOLDING FIXTURE BASE
J-8763	-	HOLDING FIXTURE
J-21368	-	PUMP BODY TO COVER ALIGNMENT BAND
J-21420-1 } J-21420-2 }	-	REVERSE CLUTCH SPRING COMPRESSOR
J-21495	-	LOW SERVO COVER REMOVER AND INSTALLER
J-7004	-	SLIDE HAMMER
J-2619	-	SLIDE HAMMER
J-5586	-	SNAP RING PLIERS
J-9578	-	SPEEDO GEAR REMOVER
J-21371	-	CONVERTER END PLAY CHECKING FIXTURE
J-21361	-	CHECK VALVE SEAT REMOVER
J-21558	-	CHECK VALVE SEAT INSTALLER
J-21547	-	MODULATOR LIMIT VALVE SPRING COMPRESSOR
J-9534	-	PLANET CARRIER BUSHING REMOVER
J-21421	-	SPEEDO GEAR INSTALLER
J-8001	-	DIAL INDICATOR SET
J-21366	-	CONVERTER HOLDING STRAP
J-4880	-	SNAP RING PLIERS
J-2590	-	FORWARD CLUTCH SPRING COMPRESSOR
J-9738	-	OUTER SHIFT LEVER SEAL INSTALLER
J-21359	-	OIL PUMP SEAL INSTALLER
J-21426	-	CASE EXTENSION OIL SEAL INSTALLER
J-8093	-	DRIVE HANDLE
J-21424	-	BUSHING SET
J-1313	-	FT. LB. TORQUE WRENCH
J-5853	-	IN. LB. TORQUE WRENCH
J-21369	-	CONVERTER PRESSURE CHECK FIXTURE

Figure 5-371—Special Tool Identification

GROUP 5

SUPER TURBINE "400" AUTOMATIC TRANSMISSION

SECTION IN GROUP 5

SECTION 5-A

AUTOMATIC TRANSMISSION SPECIFICATION AND OPERATION

CONTENTS OF SECTION 5-A

5-1 AUTOMATIC TRANSMISSION GENERAL SPECIFICATIONS

a. Transmission Identification Number

A production identification number is stamped on a metal tag, located in the lower left side of the transmission case.

The production code number is located along the bottom of the tag. See Figure 5-1. Since the production identification number furnishes the key to construction and interchangeability of parts in each transmission, the number should be used when selecting replacement parts as listed in the master parts list. The number should always be furnished on product reports, AFA forms, and all correspondence with the factory concerning a particular transmission.

b. General Specifications

Oil Capacity	22 Pints
Oil Capacity indicated between Marks on Gauge Rod	1 Pint
Oil Specification	Automatic Transmission Fluid Type A, Suffix A
Drain and Refill Mileage and Change Filter Recommendations	24,000 Mi.
Planetary Gearing Type	Compound

Use a reliable torque wrench to tighten the attaching bolts or nuts of the parts listed below.

NOTE: These specifications are for clean and lubricated threads only. Dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Location	Thread Size	Torque Ft. Lbs.
Solenoid Ass'y to Case	1/4-20	6-10
Valve Body to Case	1/4-20	6-10
Pump Body to Cover	5/16-18	15-20
Pump Body to Cover	5/16-18	15-20
Pump Assembly to Case	5/16-18	15-20
Rear Servo Cover to Case	5/16-18	15-20
Governor Cover to Case	5/16-18	15-20
Parking Brake Bracket to Case	5/16-18	15-20
Vacuum Modulator Retainer to Case	5/16-18	15-20
Valve Body to Case	5/16-18	6-10
Oil Pan to Case	5/16-18	10-13
Case Extension to Case	3/8-16	20-25

5-2 DESCRIPTION AND MECHANICAL OPERATION

The Super Turbine Automatic 400 Transmission, is a fully automatic unit consisting primarily of a 3-element hydraulic torque converter and a compound planetary gear set. Three multiple-disc clutches, two sprag units, and two bands provide the friction elements required to obtain the desired function of the compound planetary gear set.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear set produces three forward speeds and reverse.

A hydraulic system pressurized by an internal-external type gear pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to transmission are:

Manual Linkage - To select the desired operating range.

Engine Vacuum - To operate a vacuum modulator unit.

12 Volt Electrical Signal - To operate an electrical detent solenoid.

A vacuum modulator is used to automatically sense any change in the torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

The detent solenoid is activated by an electric switch on the carburetor. When the throttle is fully open, the switch on the carburetor is closed, activating the detent solenoid and causing the transmission to downshift at speeds below approximately 70 MPH.

The selector quadrant has five selector positions: P, R, N, D, L.

P. - Park position positively locks the output shaft to the transmission case by means of a locking pawl to prevent the vehicle from rolling either direction. This position should be selected whenever the driver leaves the vehicle. The engine may be started in park position.

R. - Reverse enables the vehicle to be operated in a reverse direction.

N. - Neutral position enables the engine to be started and run without driving the vehicle.

DR. - Drive position is used for all normal forward driving. It allows the transmission to automatically upshift and downshift through the various speeds to provide the most desirable engine-to-rear-wheel ratios.

L. - Lo range prevents the transmission from shifting out of first gear, and should be used where maximum torque multiplication is desired, such as pulling a heavy load or descending a steep grade. Lo range can be selected at any vehicle speed, and the transmission will shift to second gear and remain in second gear until vehicle is reduced to the normal 2-1 downshift speed.

a. Neutral—Engine Running

In neutral, all clutches and bands are released; therefore no power is transmitted from the torque converter turbine to the planetary gear train and output shaft.

b. Low Range—First Speed

With the selector lever in Drive Range, the forward clutch is applied. This delivers turbine torque to the mainshaft and turns the rear internal gear in a clockwise direction. (Converter torque ratio = 2.:1.)

Clockwise motion of the rear internal gear causes the rear pinions to turn clockwise to drive the sun gear counter-clockwise. In turn, the sun gear drives the front pinions clockwise, thus turning the front internal gear, output carrier, and output shaft

clockwise in a reduction ratio of 2.4815:1. The reaction of the front pinions against the front internal gear is taken by the reaction carrier and sprag assembly to the transmission case. (Maximum torque multiplication at stall = 4.963:1)

Downshill braking is provided in Lo range by applying the rear band as this prevents the reaction carrier from overrunning on the sprag. See Figure 5-200.

c. Low Range—Second Speed

In second speed, the intermediate clutch is applied to allow the intermediate sprag to hold the sun gear against counterclockwise rotation. Turbine torque through the forward clutch is now applied through the mainshaft to the rear internal gear in a clockwise direction.

Clockwise rotation of the rear internal gear turns the rear pinions clockwise against the stationary sun gear. This causes the output carrier and output shaft to turn clockwise in a reduction ratio of 1.4815:1.

In second speed, overrun braking is provided by the front band as it holds the sun gear fixed. Without the band applied, the sun gear would overrun the intermediate sprag. See Figure 5-201.

d. Drive Range—Third Speed

In direct drive, both the forward clutch and direct clutch are applied to connect the mainshaft and sun gear shaft to the converter turbine. Turbine torque is then split; a portion being directed through the mainshaft to the rear internal gear, and the remainder through the sun gear shaft to the sun gear. This causes the planetary gear set to react against each other and turn as one unit in direct drive or a ratio of 1:1. See Figure 5-203.

e. Reverse

In reverse, the direct clutch is applied to direct turbine torque to the sun gear shaft and sun gear. The rear band is also applied, holding the reaction carrier.

Clockwise torque to the sun gear causes the front pinions and front internal gear to turn counterclockwise in reduction. The front internal gear is connected directly to the output shaft, thus providing the reverse output gear ratio of 2.0769:1. The total reverse torque multiplication at stall (converter and gear ratios) is 4.1538:1. See Figure 5-204.

f. Neutral (Engine Running)

Whenever the engine is running, line pressure is directed to the:

1. Pressure Regulator Valve
2. Converter
   a. Cooler
   b. Cooler By-Pass Valve
   c. Transmission Lubrication
   d. Lubrication Check Valve
3. Manual Valve
4. Detent Valve
5. Detent Solenoid
6. Vacuum Modulator Valve
7. 2-3 Shift Valve

Oil flows from the pump to the pressure regulator valve which regulates the output of the pump to line pressure. When the pump output exceeds the demand to meet line pressure, oil from the pressure regulator is directed to the converter feed passage to fill the converter. Oil from the converter, termed converter return oil, is directed to the transmission cooler. Oil returning from the cooler is directed to the lube system and the cooler by-pass valve. The cooler by-pass valve permits oil to be fed directly from the converter to the lube circuit if the cooler becomes restricted. To insure flow through the cooler and converter, lube oil is directed to a check valve and excessive lube pressure is exhausted.

Line pressure acts on the manual valve, detent valve, detent solenoid, and the 2-3 modulator valve. Line pressure also acts on the modulator.

SUMMARY

The converter is filled, the forward clutch is released. The transmission is in Neutral.

5-3 HYDRAULIC OPERATION

a. Pressure Control

The transmission is automatically controlled by a hydraulic system. Hydraulic pressure is supplied by the transmission IX gear type oil pump, which is engine driven. Main line pressure is controlled by a pressure regulator valve train located in the pump. This regulator controls line pressure automatically, in response to a pressure signal from a modulator valve, in such a way that the torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings. See Figure 5-205.

To control line pressure properly, a modulator pressure is used which varies in the same manner as torque input to the transmission. Since the torque input is the product of engine torque and converter ratio, modulator pressure must compensate for changes in either or both of these.

To meet these requirements, modulator pressure is regulated by engine vacuum which is an indicator of engine torque and carburetor opening, and will decrease with an increase in vehicle speed because convertor torque ratio does the same.

Figure 5-200—Low Range First Speed

Figure 5-201—Low Range-Second Speed

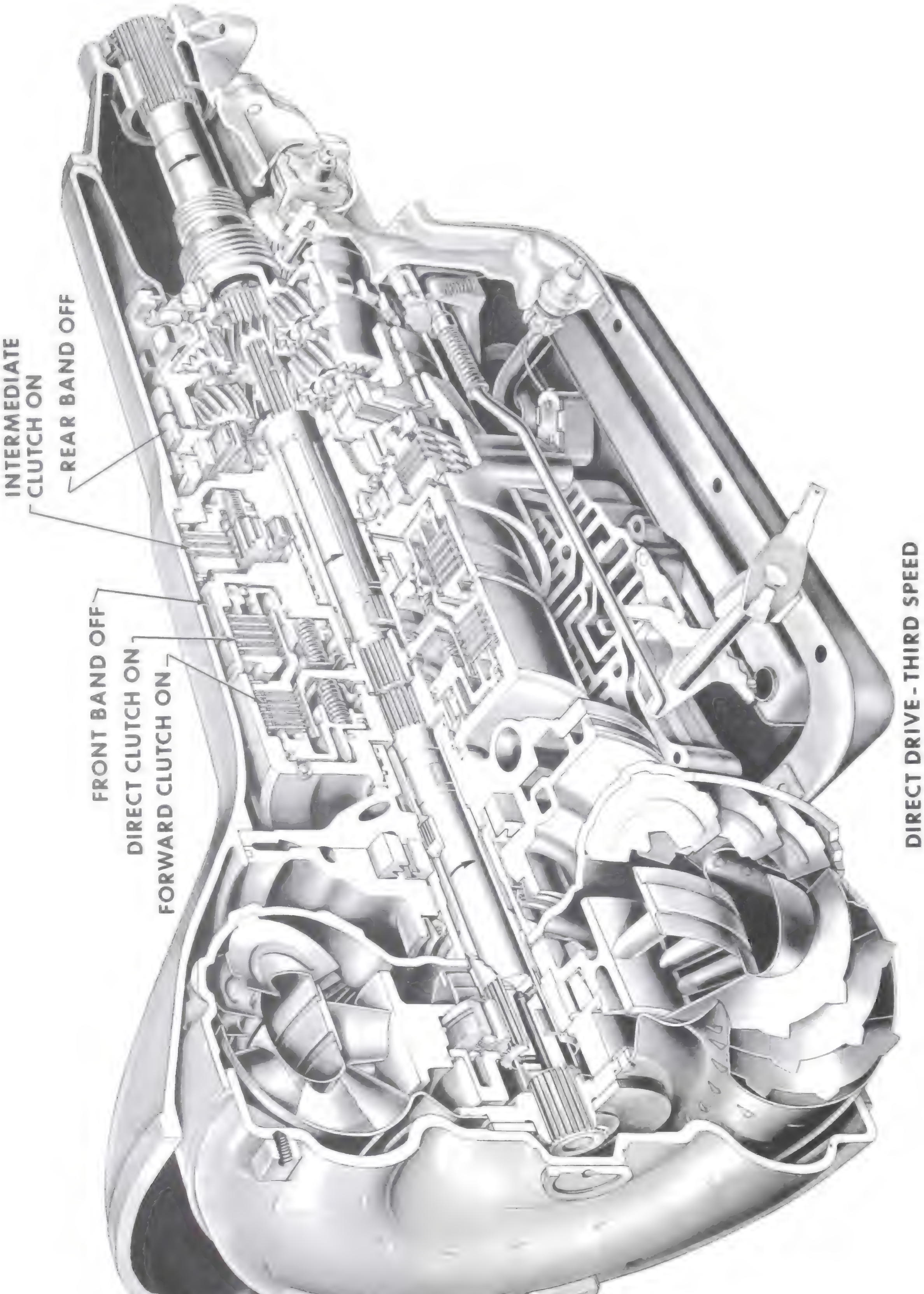


Figure 5-203—Drive Range-Third Speed

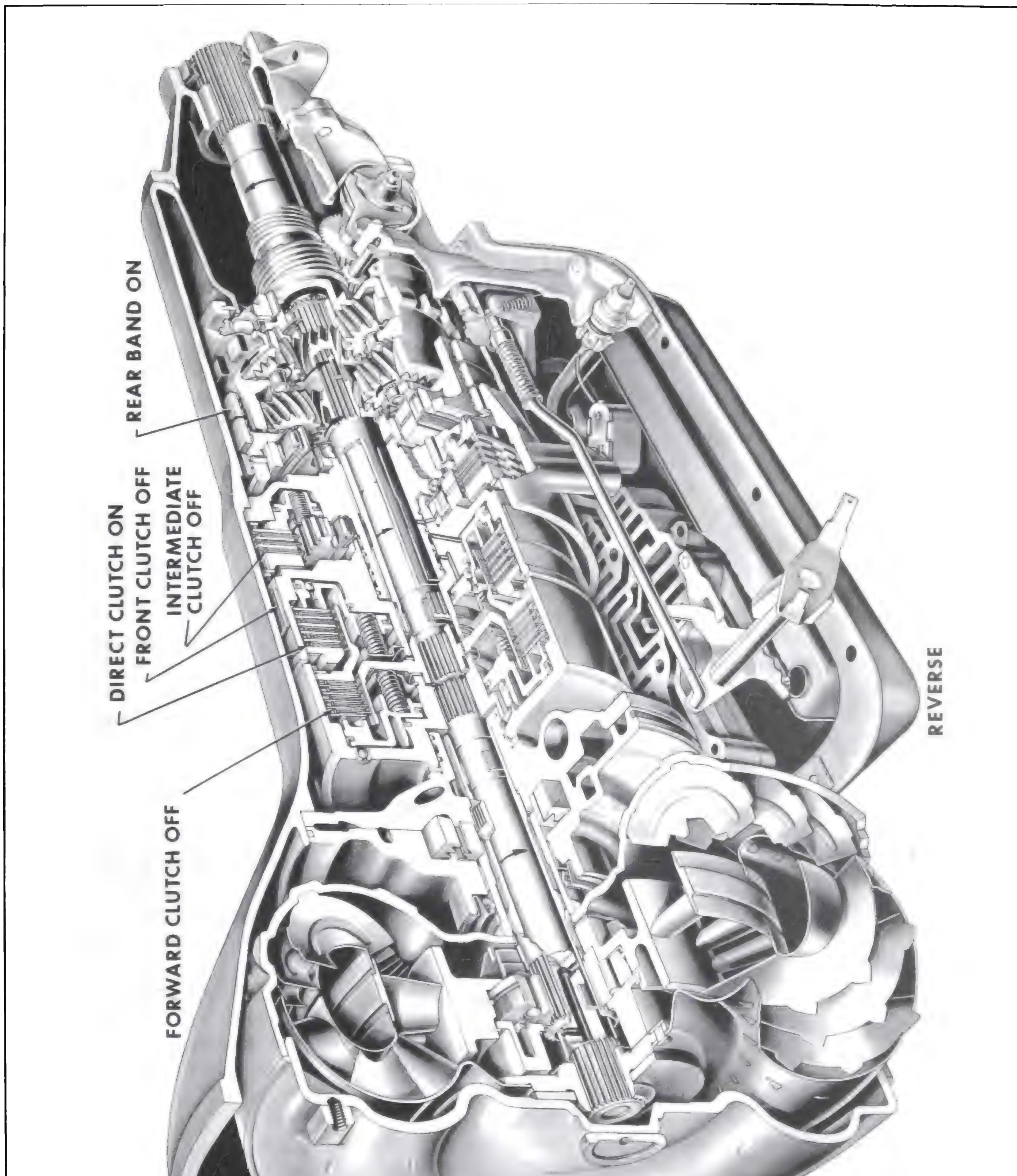


Figure 5-204—Reverse

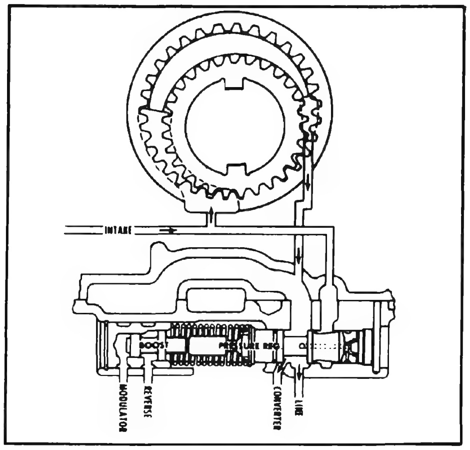


Figure 5-205—Pump and Pressure Regulator Valve

b. Vacuum Modulator Assembly

The engine vacuum signal is provided by the vacuum modulator, which consists of an evacuated metal bellows, a diaphragm and a spring. These are so arranged that when installed the bellows applies a force which acts on the modulator valve. This force acts on the modulator valve so that it increases modulator pressure. Engine vacuum and the spring acts in the opposite direction to decrease modulator, or low engine vacuum, high modulator pressure; high engine vacuum, and low modulator pressure. See Figure 5-206.

If the diaphragm area were exactly equal to the bellows area, the resulting force would match the torque characteristics of the engine very well. It would be accurate at any altitude because it would depend only on engine vacuum and be unaffected by atmospheric pressure. In practice, however, it has been discovered that such a vacuum modulator would lower shift points more than is desirable at high altitudes. This would adversely affect performance particularly when climbing mountains.

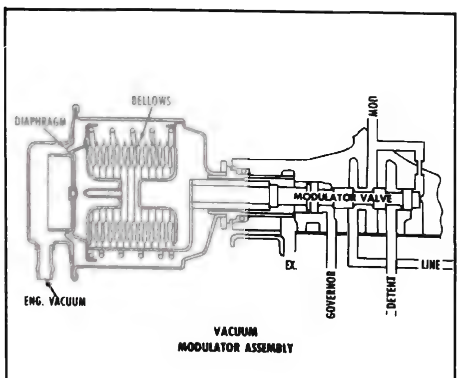


Figure 5-206—Vacuum Modulator Assembly

To reduce the effect of altitude on shift points, the effective area of the diaphragm is made somewhat larger than that of the bellows. Atmospheric pressure then acts on the resulting differential area to reduce modulator pressure.

c. Governor Assembly

The vehicle speed signal to the modulator valve is supplied by the transmission governor, which is driven by the output shaft. The governor consists of two flyweights and a regulator valve. Centrifugal force of the flyweights is imposed on the regulator valve, causing it to regulate a pressure signal that increases with speed. See Figure 5-207.

Centrifugal force is proportional to the square of vehicle speed. This means that a given change in vehicle speed results in a smaller change in governor pressure at low speeds than at high speeds. Because of this characteristic a governor with a single weight only is less accurate at low speed than at high speed. To increase the accuracy of the governor signal at low speeds, the flyweights are so designed that their effective mass is greater at speeds below approximately 720 output RPM than it is above this speed.

This is done by dividing each flyweight into two parts and arranging them so that the primary weights act through preloaded springs on the secondary weights, which in turn acts on the valve. At approximately 720 RPM the centrifugal force on each primary weight exceeds the spring force and the primary weights move to a grounded stop. With the primary weights grounded, the force on the governor regulator valve is equal to the spring forces plus the centrifugal force on the secondary weights.

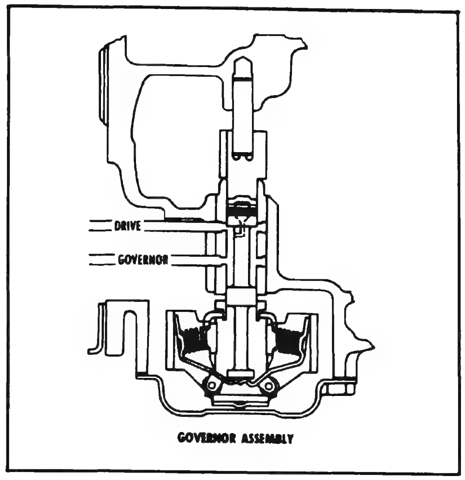


Figure 5-207—Governor Assembly

Governor pressure acts on the modulator valve to cause modulator pressure to decrease as vehicle speed increases.

5-4 FUNCTIONS OF VALVE AND HYDRAULIC CONTROL UNITS

1. Pressure Regulator

a. Regulates line pressure according to a variable spring force which is controlled by modulator and reverse pressure. See Figure 5-208.

b. Controls the flow of oil that charges the torque convertor.

2. Manual Valve

Establishes the range of transmission operation, ie P, R, N, DR, LO, as selected by the vehicle operator through the manual selector lever. See Figure 5-210.

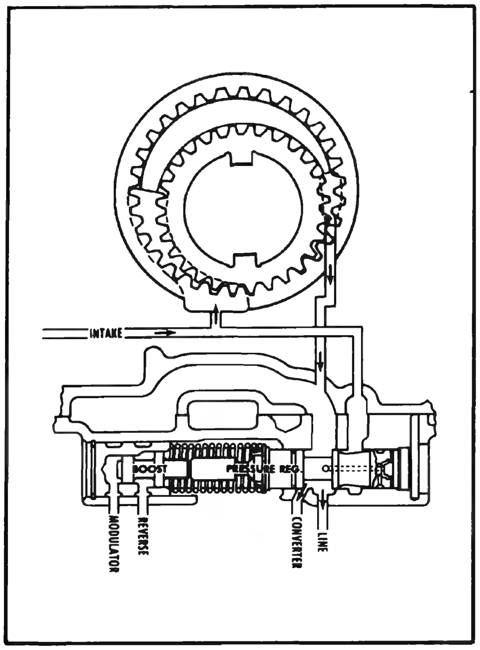


Figure 5-208—Pressure Regulator

3. Governor Assembly

Generates a speed sensitive oil pressure that increases with output shaft or vehicle speed. Governor pressure is used to control the shift points and modulator pressure regulation. See Figure 5-211.

4. Modulator Valve

Regulates line pressure to modulator pressure that varies with torque to the transmission. See Figure 5-212. It senses forces created by:

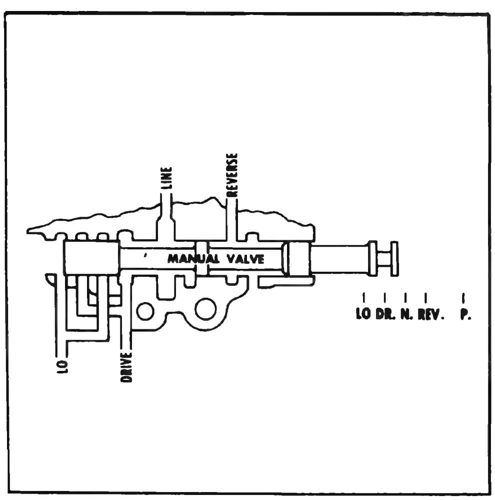


Figure 5-210—Manual Valve

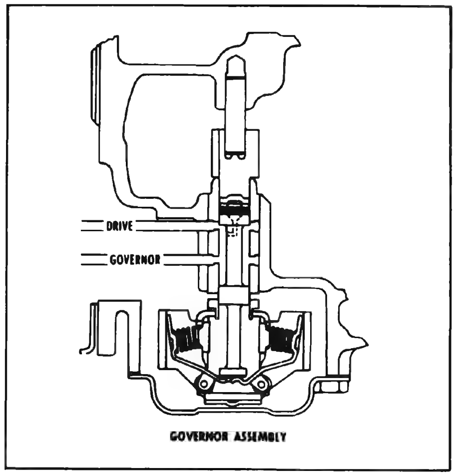


Figure 5-211—Governor Assembly

a. The vacuum modulator bellows that increases modulator pressure.

b. Engine vacuum acting on a diaphragm to decrease modulator pressure.

c. Governor pressure which is generated by the governor assembly. Governor pressure tends to decrease modulator pressure.

5. 1-2 Shift Valve

Controls the oil pressure that causes the transmission to shift from 1-2 or 2-1. Its operation is controlled by governor pressure, detent pressure, modulator pressure, Lo pressure and a spring force. See Figure 5-213.

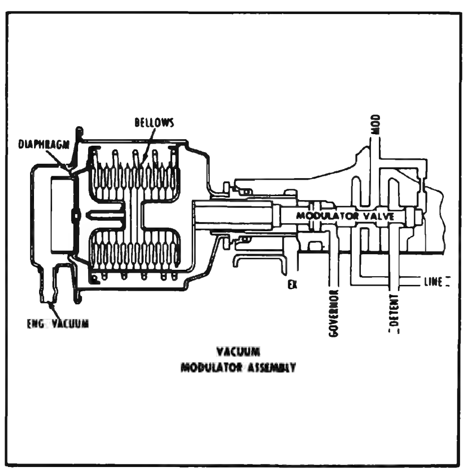


Figure 5-212—Vacuum Modulator Valve

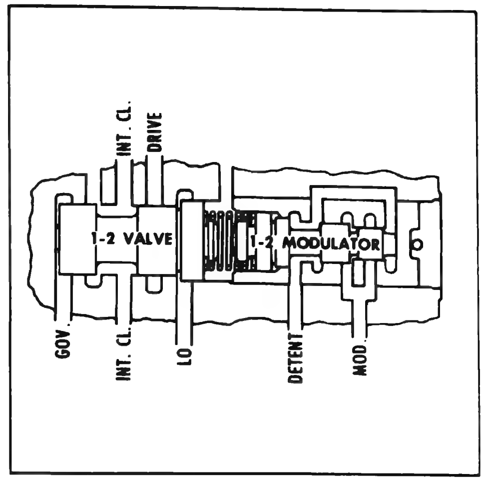


Figure 5-213—1-2 Shift Valve and 1-2 Modulator Valve

6. 1-2 Modulator Valve

Acts as a buffer to control the modulator pressure forces tending to keep the 1-2 shift valve in the downshift position. See Figure 5-213.

7. 2-3 Shift Valve

Controls the oil pressure that causes the transmission to shift from 2-3 or 3-2. Its operation is controlled by line, modulator, intermediate, governor and detent pressure as well as a spring force. See Figure 5-214.

8. 2-3 Modulator Valve

Senses modulator pressure to apply a variable force proportional to modulator pressure

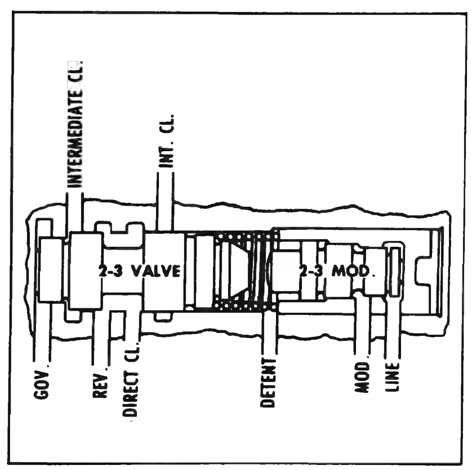


Figure 5-214—2-3 Shift Valve and 2-3 Modulator Valve

which tends to hold the 2-3 shift valve downshifted. See Figure 5-214.

9. 3-2 Valve

Shuts off modulator pressure from acting on the shift valve trains after the direct clutch has been applied. The valve shifts when direct clutch pressure is 26 psi greater than modulator pressure. This allows fairly heavy throttle operation in third speed without downshifting. In third speed detent pressure can be directed to the shift valves to provide the downshift forces. See Figure 5-215.

10. 1-2 Accumulator Valve

Regulates drive oil to a proportional lesser value, and is used in the rear accumulator to compensate for variations in engine torque during the 1-2 shift. Detent pressure and Lo oil cause higher pressure to become available.

11. Detent Valve

Shifts when line oil is exhausted at the end of the valve when the solenoid is energized. This blocks modulator pressure from flowing to the 1-2 and 2-3 modulator valves, and also allows the detent regulator valve to regulate. See Figure 5-216.

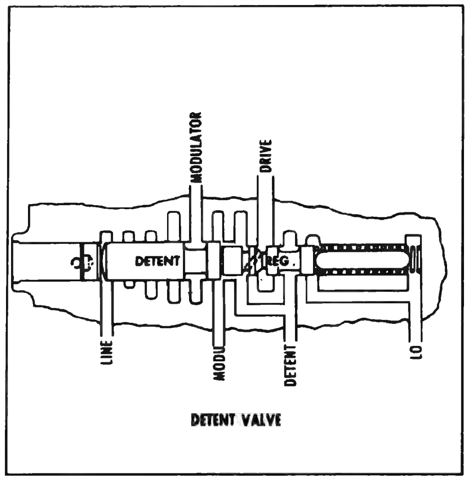


Figure 5-216—Detent Valve and Detent Regulator Valve

12. Detent Regulator Valve

When the detent valve shifts, the detent regulator is freed to allow drive oil to enter the detent passage and thus becomes regulated to a value of 56 psi. Detent pressure will also flow into the modulator passage which flows to the shift valves. Lo oil holds the detent regulator against line oil allowing drive oil to enter the modulator and detent passages. See Figure 5-516.

13. Rear Servo and Accumulator Assembly

The rear servo and accumulator assembly serves a three fold function, namely:

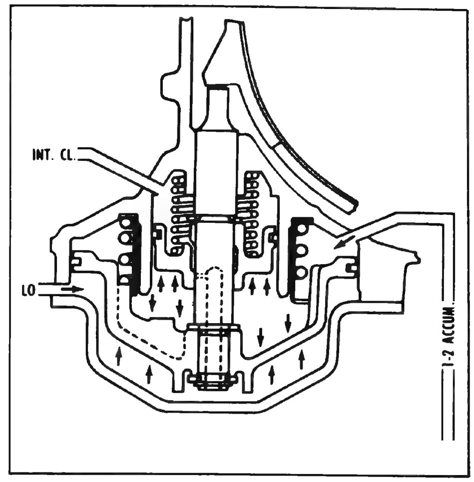


Figure 5-218

a. The large reverse band apply piston provides the band apply force to hold the rear band in reverse. See Figure 5-217.

b. The accumulator piston provides the band apply force for over-run band apply in lo range first speed. See Figure 5-218.

c. The accumulator piston in conjunction with 1-2 accumulator oil provides the accumulator function for intermediate clutch apply. During the stroke of the accumulator piston a quantity of intermediate clutch oil is allowed to bleed to exhaust through the orifice in the accumulator to functionally appear as though it could absorb a larger volume. See Figure 5-220.

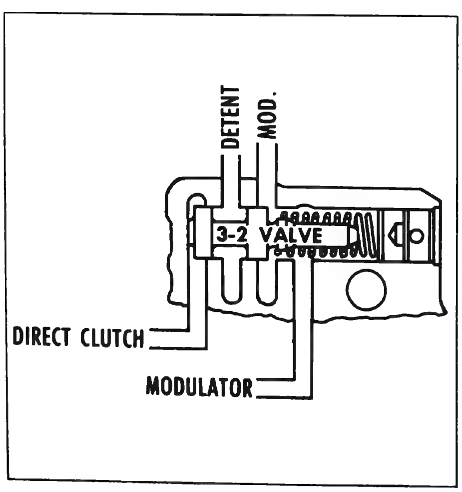


Figure 5-215—3-2 Valve

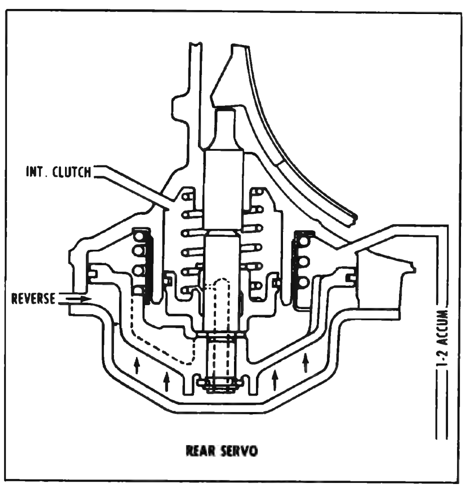


Figure 5-217

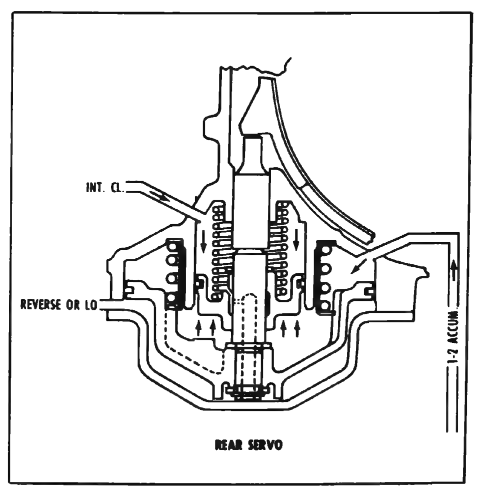


Figure 5-220

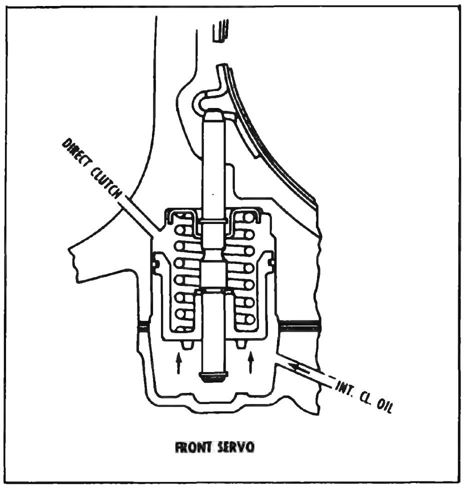


Figure 5-221

14. Front Servo

The front servo serves two functions:

a. Intermediate clutch oil applies the front servo to apply the front band in second gear. See Figure 5-221.

b. During a 2-3 shift, direct clutch oil releases the front band and utilizes the servo as an accumulator for direct clutch apply. See Figure 5-222.

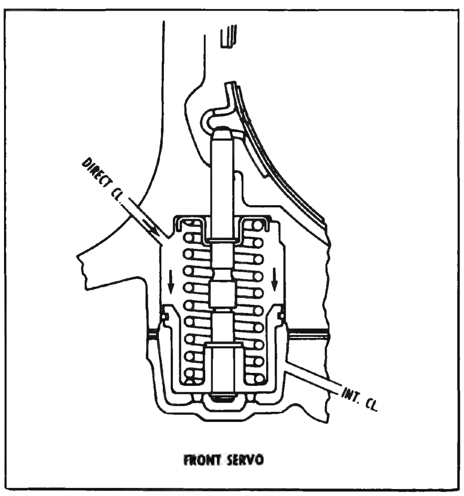


Figure 5-222

5-5 HYDRAULIC OPERATION

a. Drive Range—First Gear

Moving the selector lever to the Drive position, the manual valve is repositioned to allow line pressure to enter the Drive circuit. Drive oil then flows to the following: See Figure 5-223.

1. Forward Clutch
2. 1-2 Shift Valve
3. Governor
4. 1-2 Accumulator Valve
5. Detent Regulator Valve

Drive oil is directed to the forward clutch where it acts on two areas of the clutch piston to apply the forward clutch. The first, or smaller area of the piston, is fed through an unrestricted passage. The larger area is fed through a restricting orifice to insure a smooth shift from Neutral to Drive.

Drive oil is regulated to a variable pressure by the governor. This pressure, termed governor oil, increases with vehicle speed and acts against the ends of the 1-2 and 2-3 shift valves and the modulator valve.

Drive oil to the 1-2 accumulator valve is regulated to a pressure called 1-2 accumulator oil, which is directed between the reverse piston and the accumulator piston of the rear servo. Oil from the 1-2 accumulator strokes the accumulator piston against its spring.

b. Drive Range—Second Gear

As both vehicle speed and governor pressure increase, the force of governor oil acting on the 1-2 shift valve will overcome the force of the 1-2 shift valve spring and the modulator oil pressure. This allows the 1-2 shift valve to open, permitting drive oil to enter the intermediate clutch. Oil in this passage is termed intermediate clutch oil. See Figure 5-224.

Intermediate clutch oil from the 1-2 shift valve is directed to:

1. Intermediate Clutch
2. Rear Servo
3. Front Servo
4. 2-3 Shift Valve (To be used on the 2-3 shift)

Intermediate clutch oil from the 1-2 shift valve seats a one way check ball and flows through an orifice to the intermediate clutch piston to apply the intermediate clutch. At the same time, intermediate clutch oil plus the accumulator spring, strokes the accumulator piston of the rear servo against the 1-2 accumulator oil for a smooth clutch apply. Intermediate clutch oil seats a second one way check ball and flows to the front servo through an orifice to apply the front band. Front band application occurs only after the intermediate clutch is fully applied, due to location of the second orifice and the strength of the front servo spring. The oil that is applying the band is also directed to the 2-3 shift valve and will cancel the effect of line oil on the 2-3 modulator valve after the band is applied.

c. Third Gear

As vehicle speed and governor pressure increase, the force of governor oil acting on the 2-3 shift valve overcomes the force of the 2-3 shift valve spring and modulator oil. This allows the 2-3 shift valve to move, feeding intermediate clutch oil to the direct clutch passage. This oil is now termed direct clutch oil. See Figure 5-225.

From the 2-3 shift valve, direct clutch oil is directed to:

1. Direct Clutch
2. Front Servo
3. 3-2 Valve

Direct clutch oil from the 2-3 shift valve flows past a one way check valve to the small inner area of the direct clutch piston

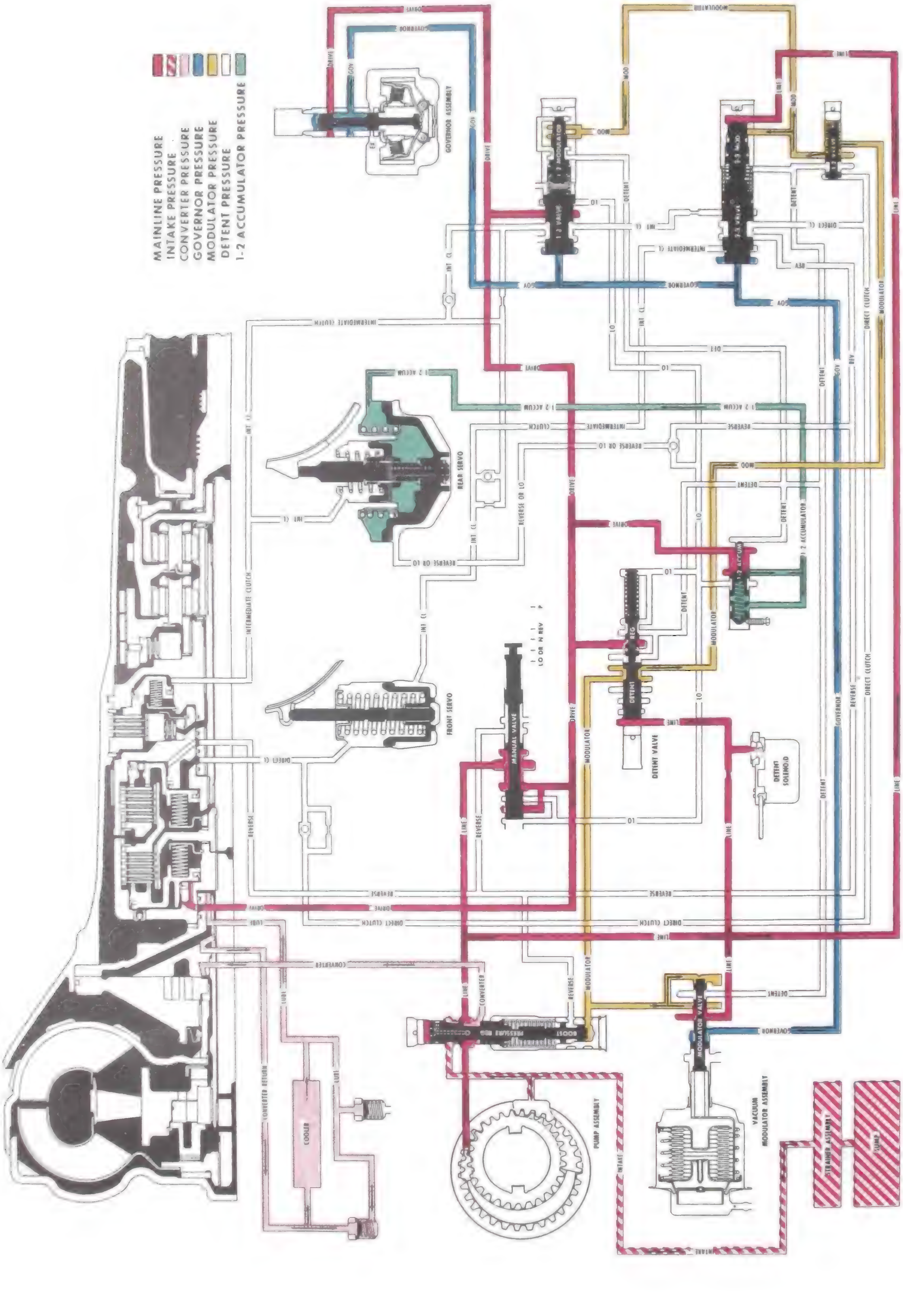


Figure 5-223—Drive Range - First Gear

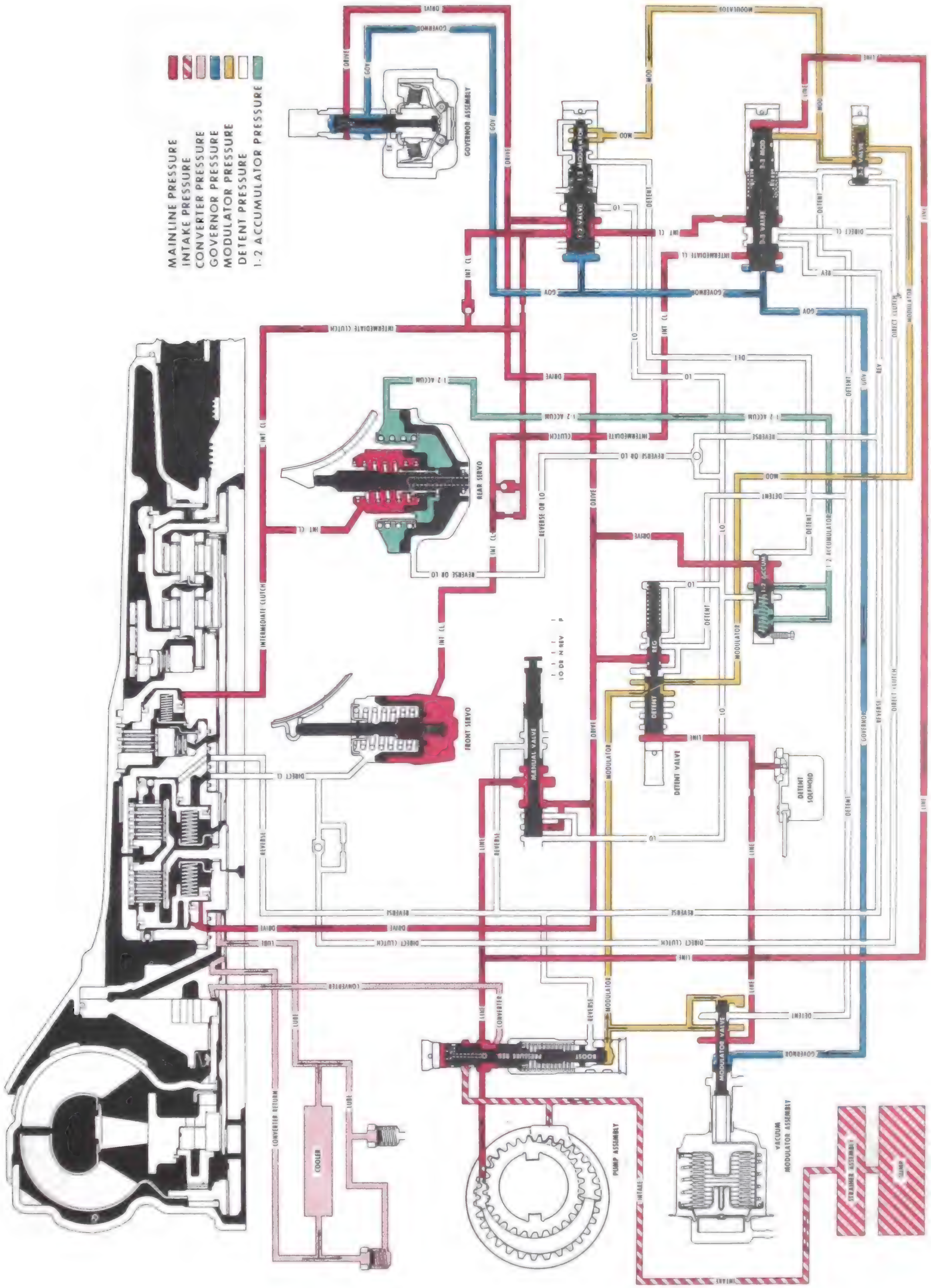


Figure 5-224—Drive Range - Second Gear

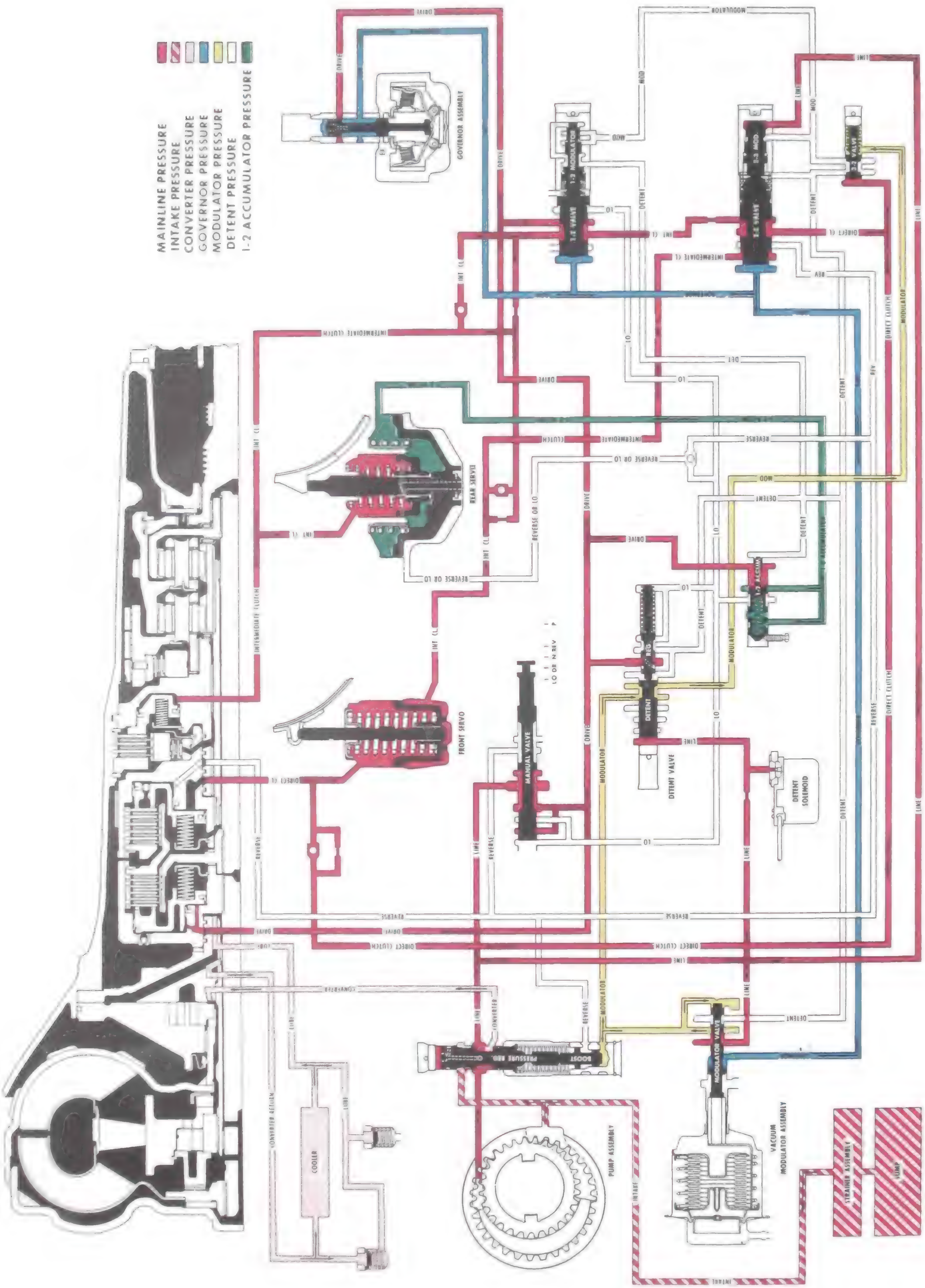


Figure 5-225—Third Gear Drive

to apply the direct clutch. Simultaneously, direct clutch oil is fed to the front servo to release the band.

The pressure of the direct clutch oil, combined with the front servo spring, moves the front servo piston against the intermediate clutch oil pressure. The front servo releases the band and acts as an accumulator for a smooth direct clutch apply.

Direct clutch oil is also supplied to the 3-2 valve to move the 3-2 valve against its spring and modulator pressure when modulator pressure is below 94 psi. This cuts off modulator oil to the 1-2 and 2-3 modulator valves and allows the transmission to utilize the torque multiplying characteristics of the converter without downshifting.

When modulator pressure is above 94 psi, the 3-2 valve will move against direct clutch oil and allow modulator oil to act on the 2-3 and 1-2 shift valves.

SUMMARY

The forward, intermediate, and direct clutches are applied. The transmission is in Third Gear (Direct Drive).

d. Reverse

When the selector lever is moved to the reverse position, the manual valve is repositioned to allow line pressure to enter the reverse circuit. Reverse oil then flows to the following components: See Figure 5-226.

1. Direct Clutch
2. 2-3 Shift Valve
3. Rear Servo
4. Pressure Boost Valve

Reverse oil from the manual valve flows to the large area of the direct clutch piston and to the 2-3 shift valve. From the 2-3 shift valve, it enters the direct clutch passage and is directed to the small area of the direct clutch piston to apply direct clutch.

Reverse oil flows to the rear servo and acts on the reverse piston to apply the rear band. Reverse oil also acts on the pressure boost valve to boost line pressure.

SUMMARY

The direct clutch and the rear band are applied. The transmission is in Reverse.

e. Detent Downshifts

While operating at speeds below approximately 70 miles per hour, a forced or detent 3-2 downshift is possible by depressing the accelerator fully. This engages an electrically-operated switch at the carburetor and actuates the detent solenoid. The detent solenoid opens an orifice that allows line oil at the detent valve to be exhausted, thus permitting the detent regulator valve to operate. Line oil acting on the detent valve and solenoid is supplied by a smaller orifice. This orifice will insure stable line pressure throughout the system.

Drive oil on the detent regulator valve is then regulated to a pressure of approximately 56 psi and called detent oil. Detent oil is routed into the modulator passage to the 1-2 and 2-3 modulator valves and to the 1-2 and 2-3 shift valves. Below approximately 70 mph, the 2-3 shift valve will close, allowing the transmission to shift to second gear.

A detent 2-1 downshift can also be accomplished at approximately 20 MPH by pressing the accelerator through detent, the pressure of the detent oil on the 1-2 shift and 1-2 modulator valve will further downshift the transmission to first gear.

To insure a firm 1-2 upshift under detent conditions, detent oil is directed to the 1-2 accumulator valve to increase 1-2 accumulator oil pressure acting on the rear servo accumulator piston.

f. Low Range—First Gear

(Valves in First Gear Position)

Maximum downhill braking can be attained at speeds below 20 MPH with the selector lever in Lo position as this directs Lo oil from the manual valve to the following areas:

1. 1-2 Shift Valve
2. Rear Servo
3. 1-2 Accumulator Valve
4. Detent Regulator Valve and Spacer

Lo oil to the 1-2 shift valve assists governor oil to hold the 1-2 shift valve in the upshifted position. This prevents the transmission from downshifting to first gear until the vehicle is slowed to approximately 20 MPH.

Lo oil flows past a ball check to the apply side of the rear servo piston and through the 1-2 accumulator valve to raise the 1-2 accumulator oil to line pressure. With line pressure on both sides of the rear servo piston, the accumulator piston will apply the band.

Lo oil acts on both the detent regulator valve and spacer. Combined with the detent spring, Lo oil holds the detent valve against line oil acting on the detent valve, causing drive oil to flow through the detent regulator valve into the detent and modulator passages. This increases line, detent, and modulator oil pressures to 150 psi. Modulator oil at line pressure acting on the 1-2 modulator valve overcomes both Lo and governor oil on the 1-2 shift valve at any vehicle speed below 20 MPH and the transmission will shift to first gear.

With the transmission in first gear-Lo range, the transmission

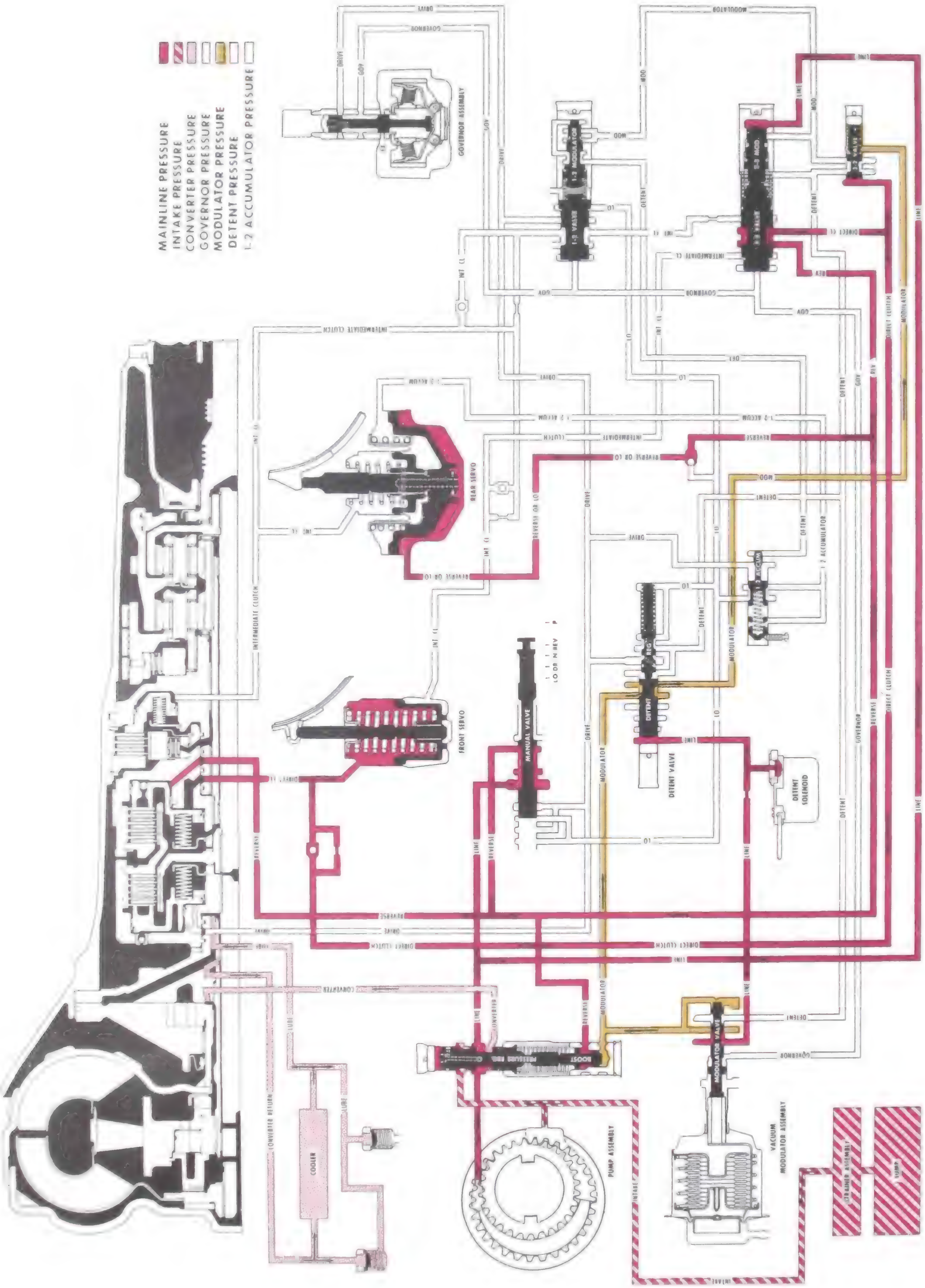


Figure 5-226—Reverse

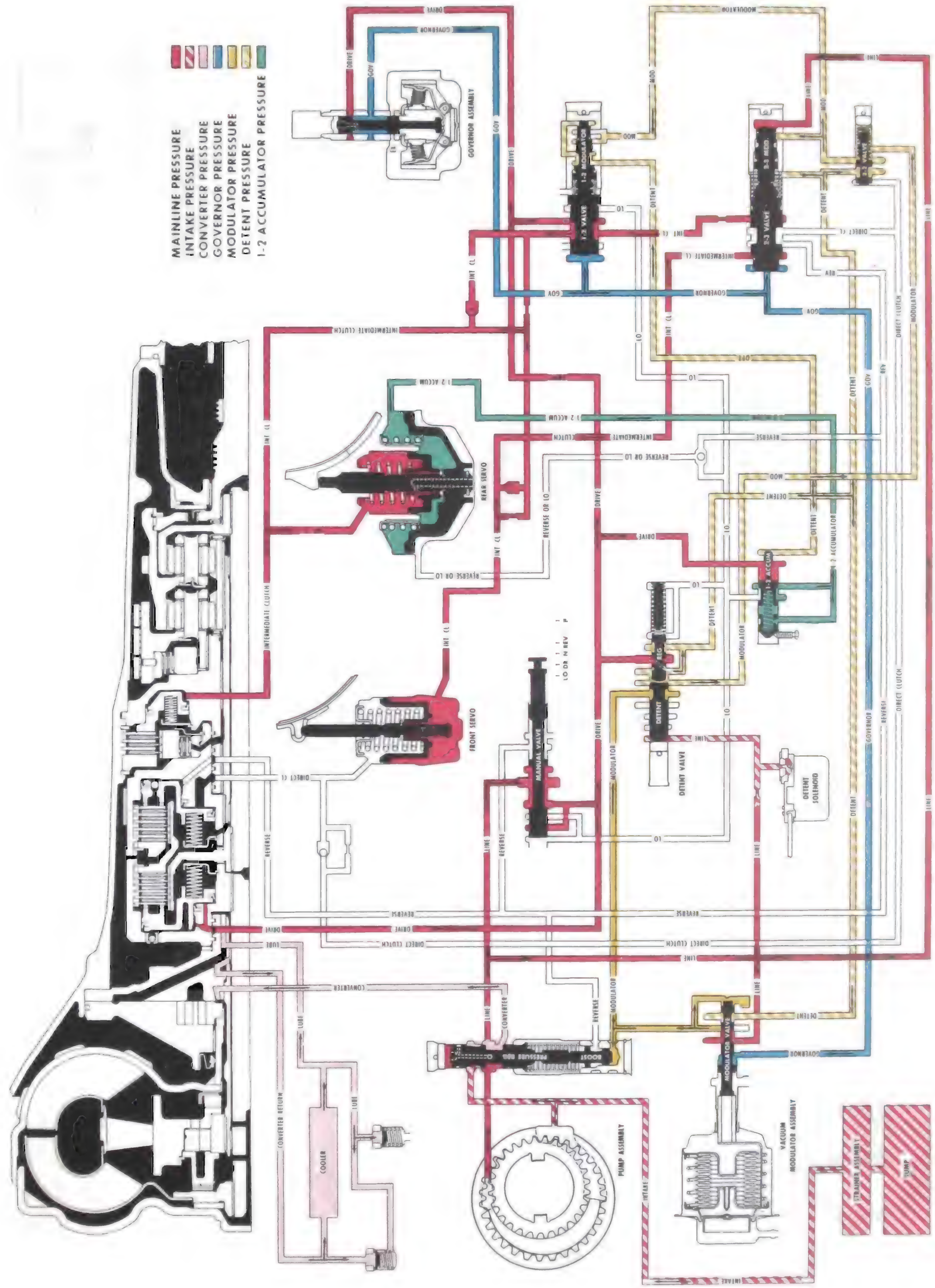


Figure 5-227—Second Gear Detent

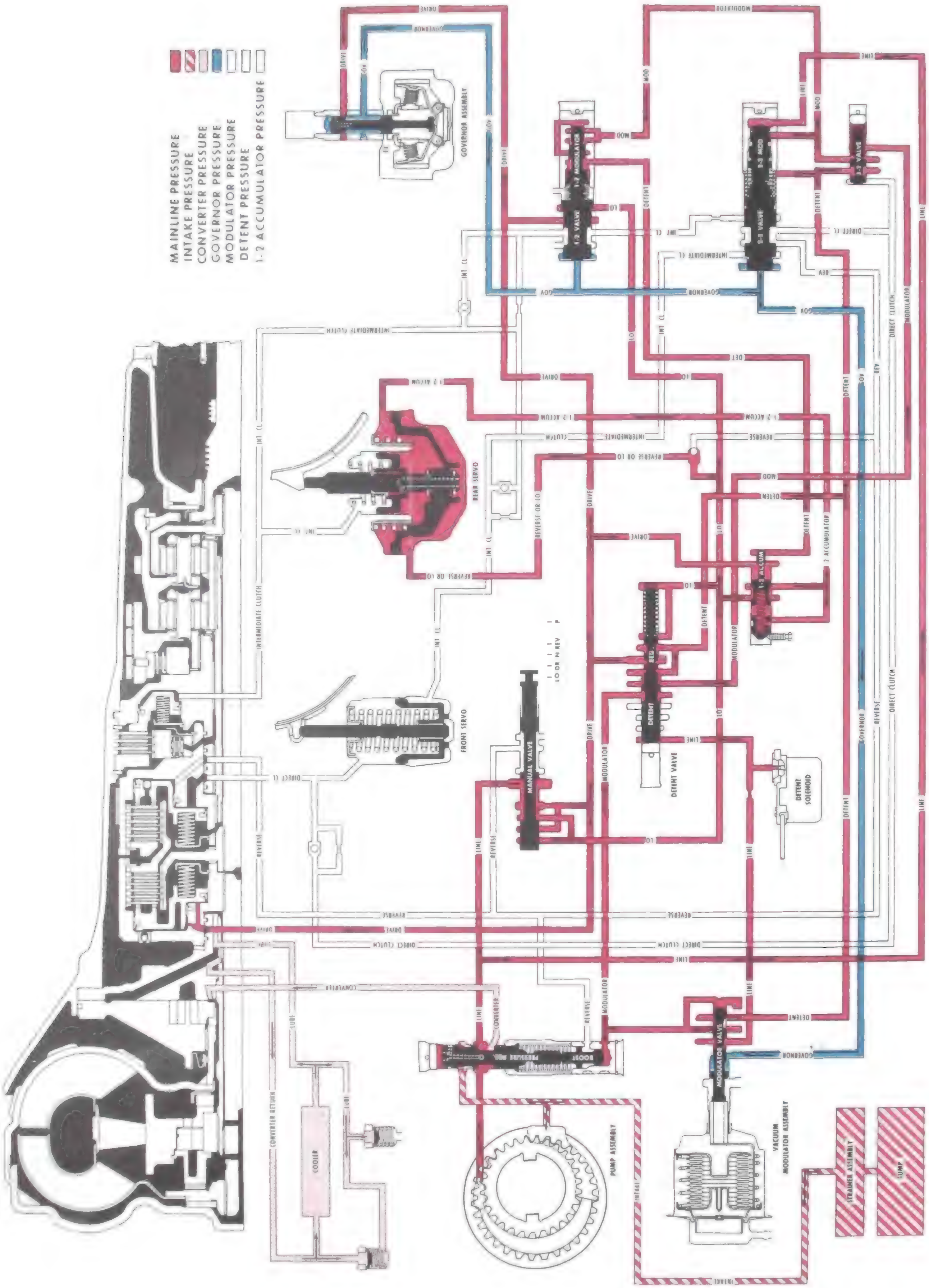


Figure 5-228—First Gear Low

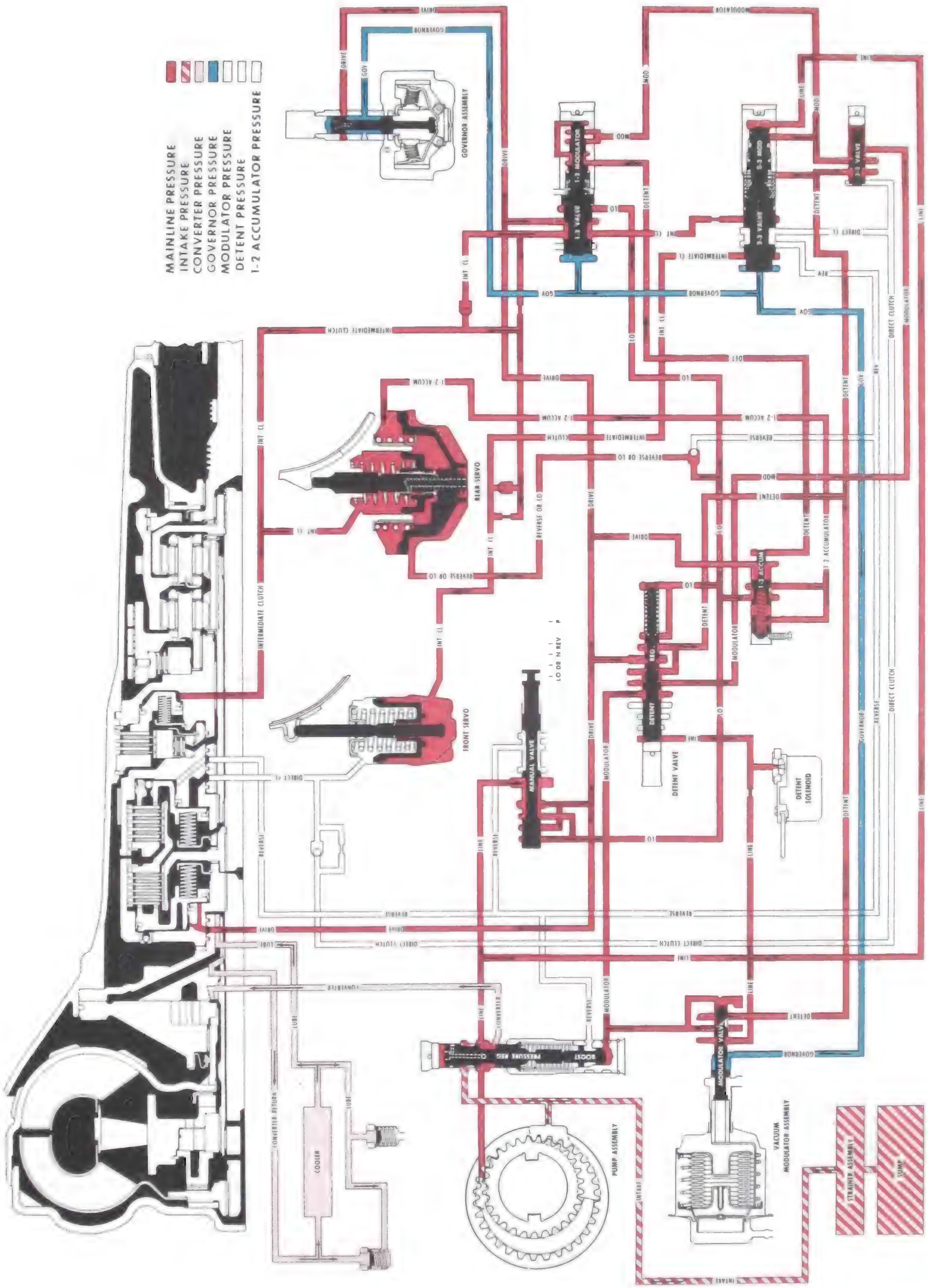
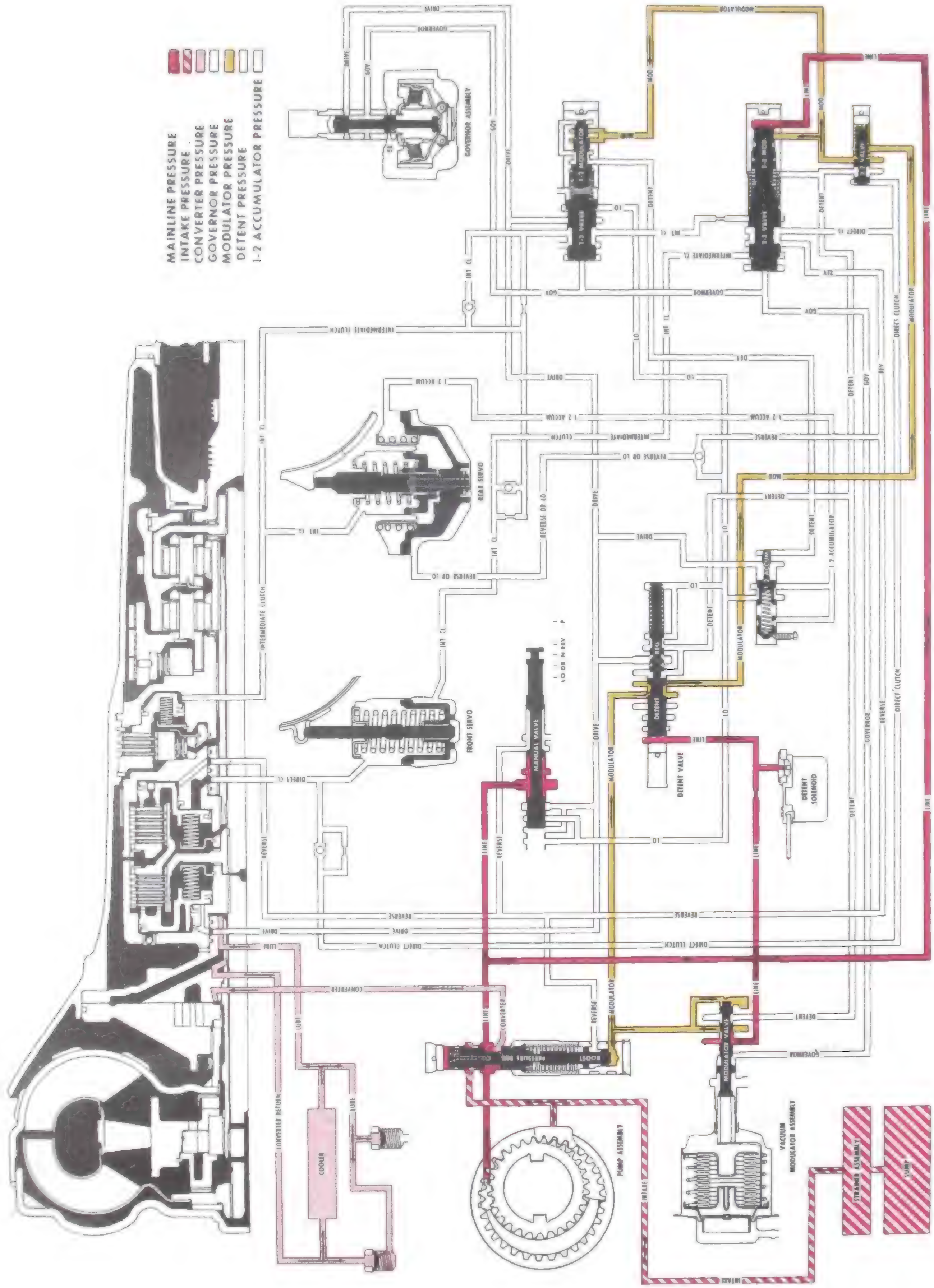


Figure 5-229—Second Gear Low



NEUTRAL POSITION

Figure 5-230

cannot upshift to second gear regardless of vehicle or engine speed.

SUMMARY

The forward clutch and rear band are applied. The transmission is in First Gear - Lo Range.

g. Low Range—Second Gear

(Valves in Second Gear Position)

A 3-2 downshift for downhill braking can be accomplished by moving the selector lever to Lo position. When the selector lever is moved to Lo position, Lo oil from the manual valve is directed to the following components:

1. Detent Regulator Valve and Spacer
2. 1-2 Shift Valve
3. Rear Servo
4. 1-2 Accumulator Valve

Lo oil from the manual valve flows to the detent regulator valve and spacer to hold the valve train against line pressure. Drive oil then flows through the detent regulator valve into the detent and modulator passages to increase line, detent, and modulator oil pressures to 150 psi. This higher pressure of the detent and modulator oil on the 2-3 shift valve will force the transmission to downshift to second gear, regardless of vehicle speed.

Lo oil is also directed to the rear servo and the 1-2 accumulator valve to boost 1-2 accumulator oil in the rear servo to 150 psi.

To keep the 1-2 shift valve upshifted until approximately 20 MPH, Lo oil is also supplied to the 1-2 shift valve.

SECTION 5-B

AUTOMATIC TRANSMISSION ADJUSTMENT ON CAR

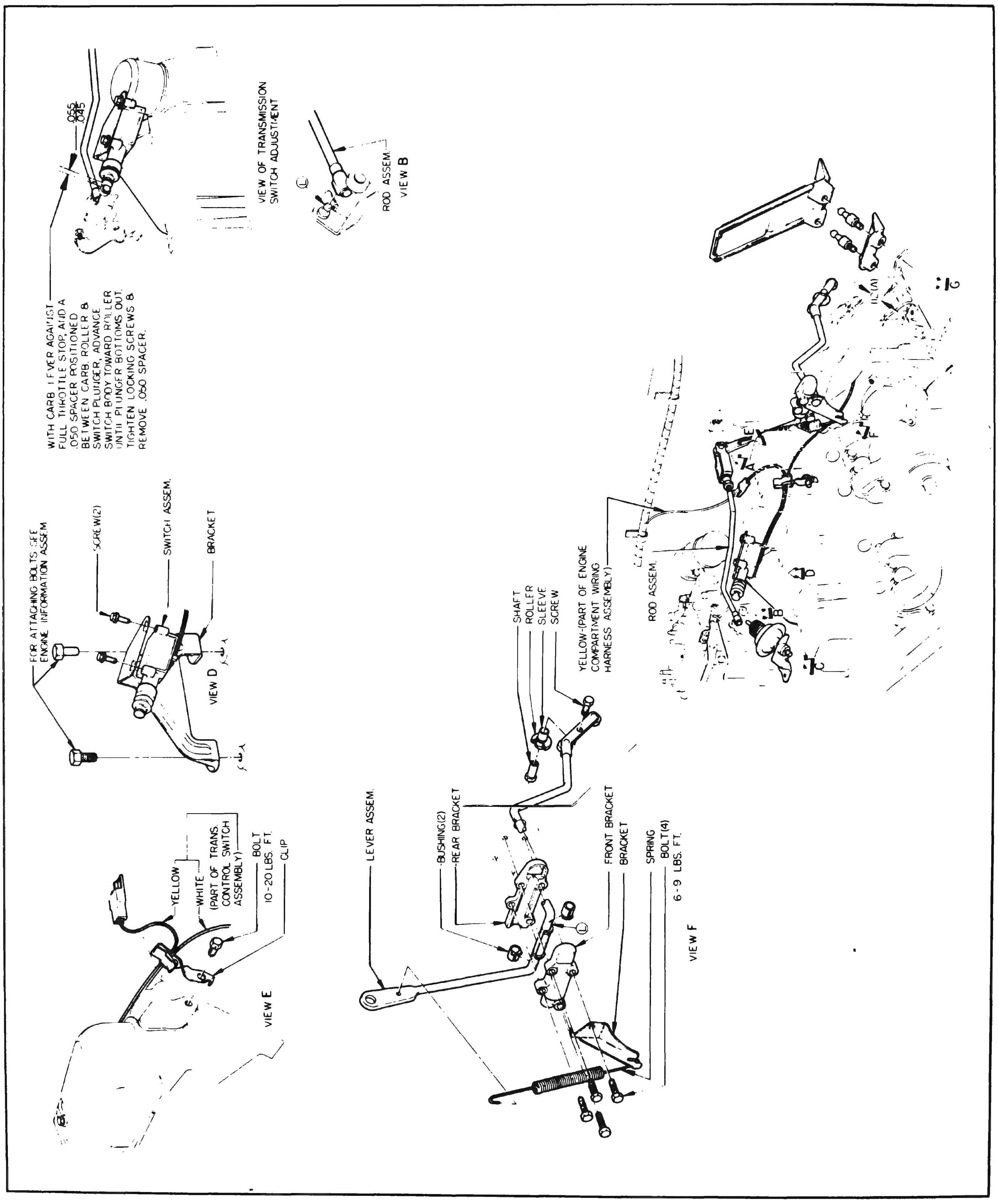


Figure 5-231—Detent Switch Adjustment

SECTION 5-C

AUTOMATIC TRANSMISSION REMOVAL & INSTALLATION

CONTENTS OF SECTION 5-C

5-7 TRANSMISSION ASSEMBLY—REMOVAL AND INSTALLATION

a. Removal

1. Raise car and provide support for front and rear of car.

2. Disconnect front exhaust pipe bolts at the exhaust manifold and at the connection of the intermediate exhaust pipe location (single exhaust only). On dual exhaust the exhaust pipes need not be removed.

3. Disconnect propeller shaft or rear companion flange, mark flange and shaft so parts may be reassembled in same relative position. Support shaft up out of the way to prevent damage to center joint caused by weight of shaft.

4. Place suitable jack under transmission and fasten transmission securely to jack.

5. Remove vacuum line to vacuum modulator hose from vacuum modulator.

6. Loosen cooler line bolts and separate cooler lines from transmission.

7. Remove transmission mounting pad to cross member bolts.

8. Remove transmission cross member support to frame rail bolts. Remove cross member.

9. Disconnect speedometer cable.

10. Loosen shift linkage adjusting swivel clamp nut. Remove cotter key, spring, and washer attaching equalizer to outer range selector lever. Remove equalizer.

11. Disconnect transmission filler pipe at engine. Remove filler pipe from transmission.

12. Support engine at oil pan.

13. Remove transmission flywheel cover pan to case tapping screws. Remove flywheel cover pan.

14. Mark flywheel and converter pump for reassembly in same position, and remove three converter pump to flywheel bolts.

15. Remove transmission case to engine block bolts.

16. Move transmission rearward to provide clearance between converter pump and crankshaft. Install Tool J-21366 to retain converter. Lower transmission and move to bench.

b. Installation

1. Assemble transmission to suitable transmission jack and raise transmission into position. Rotate converter to permit coupling of flywheel and converter with original relationship.

2. Install transmission case to engine block bolts. Torque to 30-40 ft. lbs. Do not overtighten.

3. Install flywheel to converter pump bolts. Torque to 30-40 ft. lbs.

4. Install transmission cross member support. Install mounting pad to cross member.

5. Remove transmission jack and engine support.

6. Install transmission flywheel cover pan with tapping screws.

7. Install transmission filler pipe using a new "O" ring.

8. Reconnect speedometer cable.

9. Install propeller shaft. Connect propeller shaft to pinion flange.

10. Reinstall front exhaust crossover pipe.

11. Install oil cooler lines to transmission.

12. Install vacuum line to vacuum modulator.

13. Fill transmission with oil as follows:

a. Add 4 pints of oil.

b. Start engine in neutral. DO NOT RACE ENGINE. Move manual control lever through each range.

c. Check oil level, adjust oil level to full mark on dipstick.

SECTION 5-D

TRANSMISSION DISASSEMBLY AND REASSEMBLY

CONTENTS OF SECTION 5-D

5-8 DISASSEMBLY OF MAJOR UNITS

1. With transmission in cradle on portable jack, remove J-21366, remove the converter assembly, by pulling straight out.

NOTE: The convertor contains a large amount of oil.

2. Install holding Fixture J-8763 on the transmission so that the modulator assembly will be located on the side of the holding fixture that is nearest the bench.

3. Install fixture and transmission into holding Tool Base, J-3289-20, with bottom pan facing up. See Figure 5-500.

4. Remove modulator assembly attaching screw and retainer. See Figure 5-501.

5. Remove modulator assembly and "O" ring seal from case. See Figure 5-502.

Figure 5-500

Figure 5-501

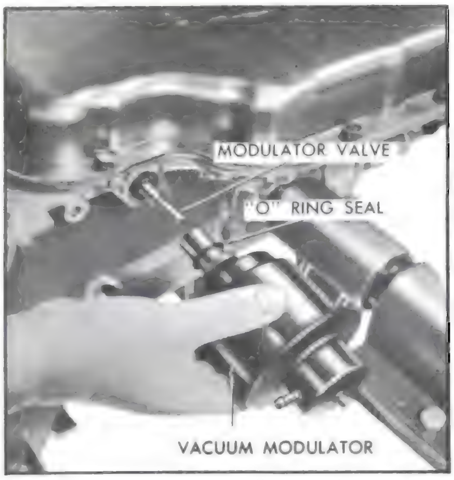


Figure 5-502

6. Remove modulator valve from transmission case.

5-9 REMOVAL OF GOVERNOR SPEEDOMETER DRIVEN, GEAR, PAN, STRAINER AND INTAKE PIPE

NOTE: The following operations can be performed with transmission in car.

1. Remove attaching screws, governor cover and gasket. See Figure 5-503.

2. Withdraw governor assembly from case.

3. Remove the speedometer driven gear attaching screw and retainer. See Figure 5-505.

Figure 5-503

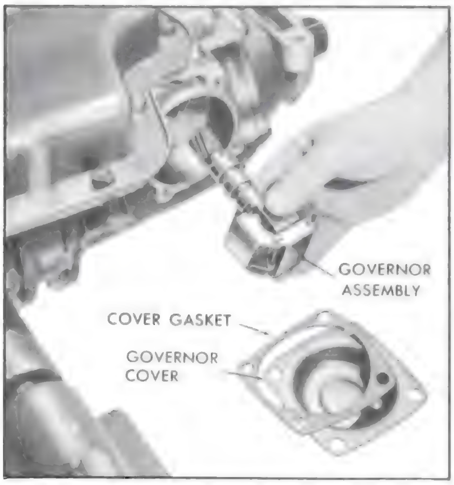


Figure 5-504

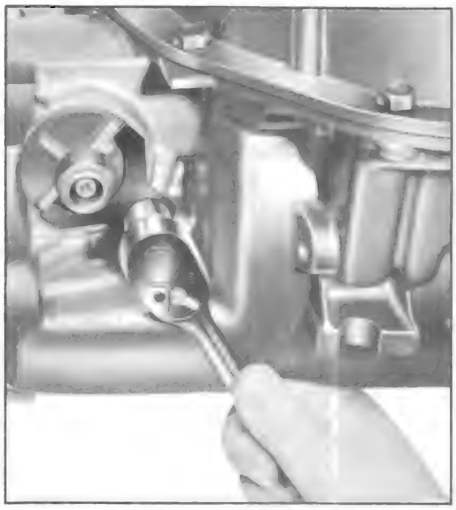


Figure 5-505

4. Withdraw speedometer driven gear assembly from case. See Figure 5-506.

Figure 5-506

5. Remove bottom pan attaching screws. See Figure 5-507.

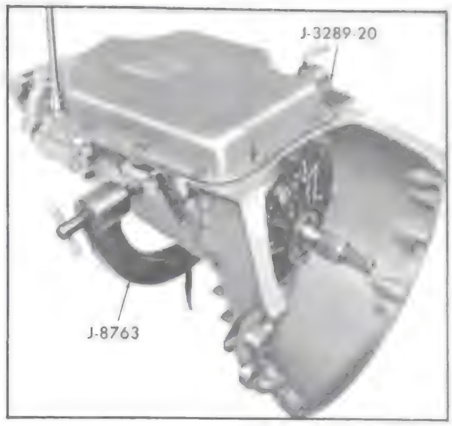


Figure 5-507

6. Remove bottom pan and gasket. See Figure 5-508.

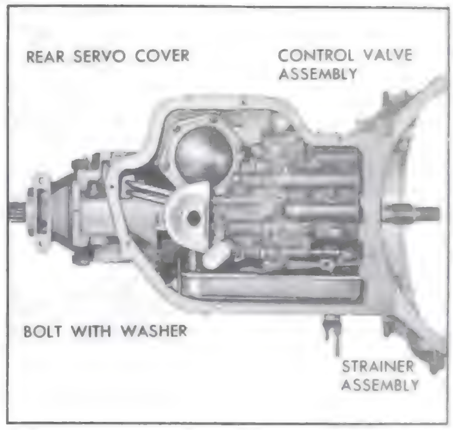


Figure 5-508

7. Remove the pump intake pipe and strainer assembly. See Figure 5-510.

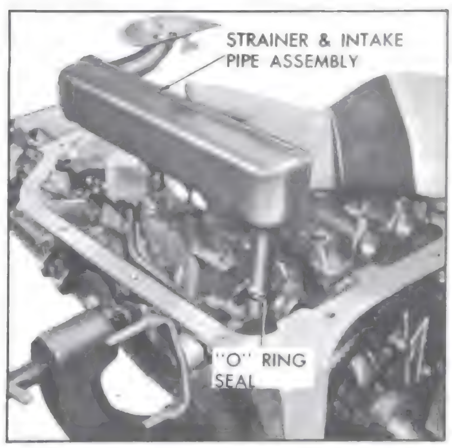


Figure 5-510

8. Remove the intake pipe to case "O" ring seal.

5-10 REMOVAL OF CONTROL VALVE ASSEMBLY, GOVERNOR PIPES AND DETENT SPRING ASSEMBLY

NOTE: The following operations can be performed with transmission in car.

1. Remove the control valve body attaching screws and detent roller and spring assembly. See Figure 5-511.

Figure 5-511

NOTE: Do not remove solenoid attaching screws.

2. Remove the control valve body assembly and governor pipes. See Figure 5-512.

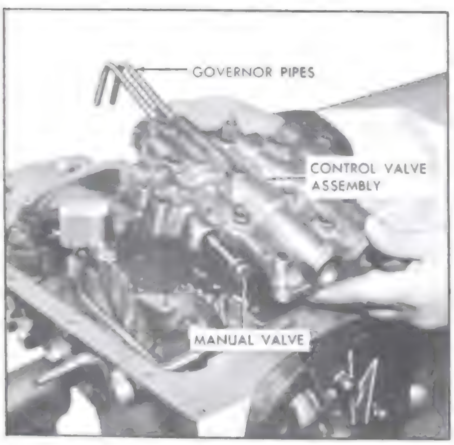


Figure 5-512

NOTE: Do not allow manual valve to fall out of control valve assembly.

3. Remove the governor pipes from control valve assembly. See Figure 5-513.

Figure 5-513

4. Remove the control valve assembly to spacer gasket. See Figure 5-514.

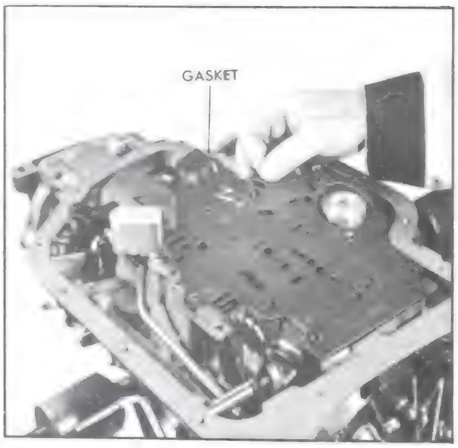


Figure 5-514

5-11 REMOVAL OF REAR SERVO, SOLENOID, CONNECTOR, VALVE BODY SPACER, GASKET, FRONT SERVO, MANUAL DETENT AND PARK LINKAGE

1. Remove the rear servo cover attaching screws, the servo cover and gasket. (Discard gasket). See Figure 5-515.

Figure 5-515

2. Remove the rear servo assembly from the case. See Figure 5-516.

Figure 5-516

3. Remove the servo accumulator springs. See Figure 5-517.

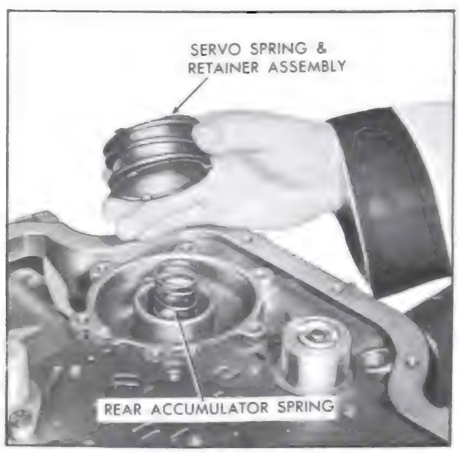


Figure 5-517

4. Disconnect solenoid lead from connector terminal. See Figure 5-518.

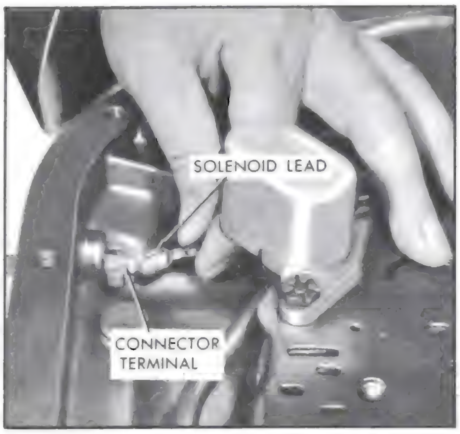


Figure 5-518

5. Compress fingers on connector and withdraw connector and "O" ring seal. See Figure 5-520.

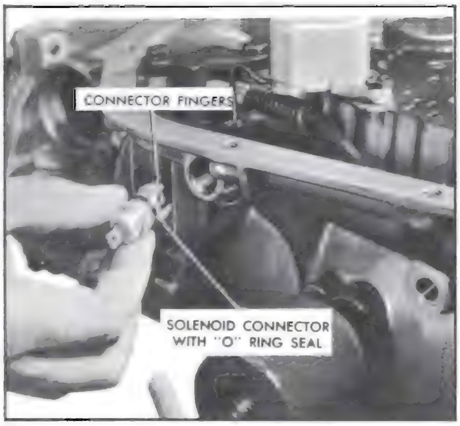


Figure 5-520

6. Remove the solenoid attaching screws, solenoid assembly and gasket. See Figure 5-521.

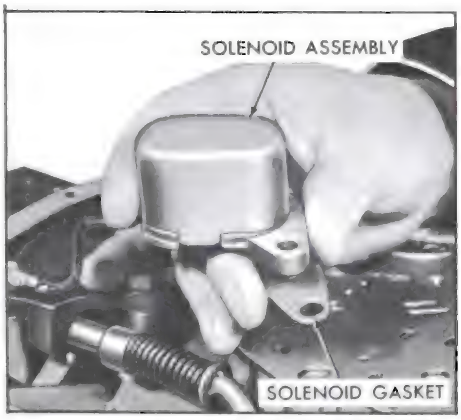


Figure 5-521

7. Remove the control valve assembly spacer plate and gasket. See Figure 5-522.

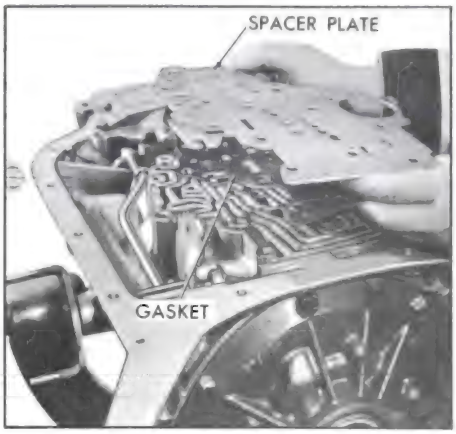


Figure 5-522

8. Remove four (4) check balls from cored passages in transmission case. See Figure 5-523.

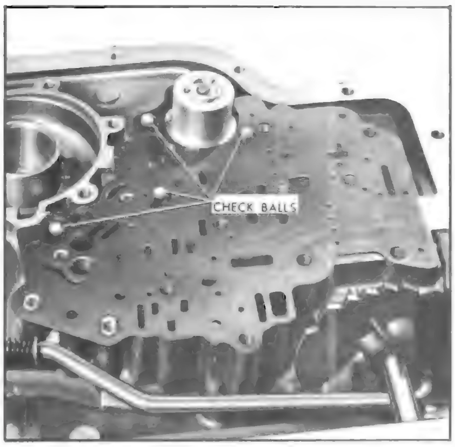


Figure 5-523

9. Remove the front servo assembly.

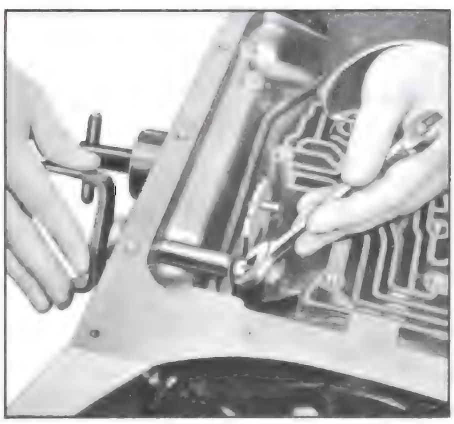


Figure 5-524

10. Unthread the jam nut holding detent lever to manual shaft. See Figure 5-524.

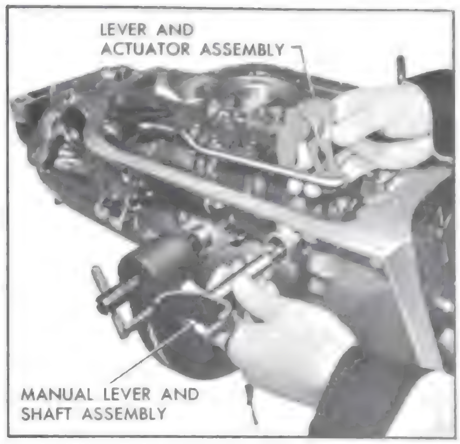


Figure 5-525

11. Remove the detent lever from the manual shaft. See Figure 5-525.

Figure 5-526

12. Remove the manual shaft from case.

NOTE: If necessary to replace, pry the manual shaft seal out of case. See Figure 5-526.

CAUTION: Do not lose the jam nut as it becomes free from the manual shaft.

13. Remove parking actuator rod and detent lever assembly.

14. If necessary, remove the detent lever retaining "E" ring and detent lever. See Figure 5-527.

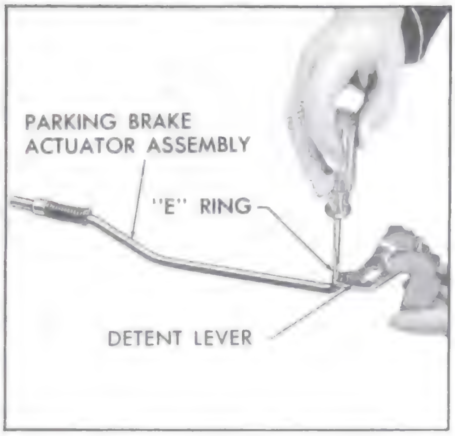


Figure 5-527

15. Remove attaching screws and parking bracket. See Figure 5-228.

Figure 5-528

16. Remove parking pawl return spring. See Figure 5-529.

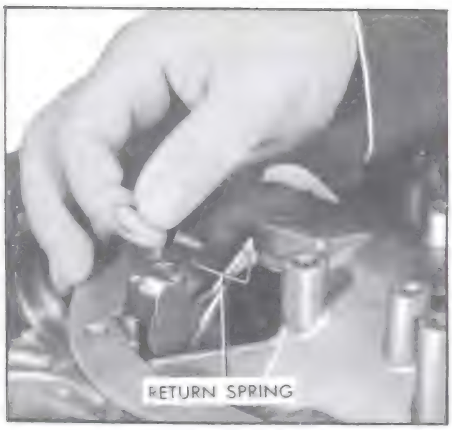


Figure 5-529

17. Remove parking pawl shaft retainer. See Figure 5-530.

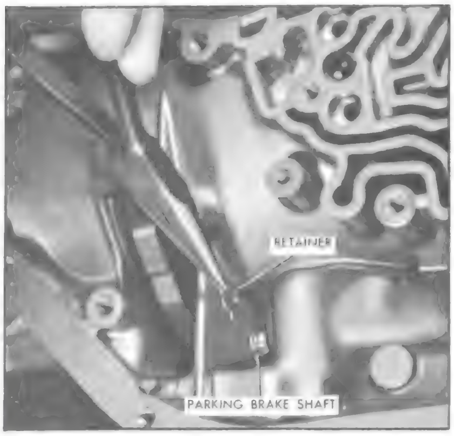


Figure 5-530

18. Remove parking pawl shaft, "O" ring seal and parking pawl. See Figure 5-531.

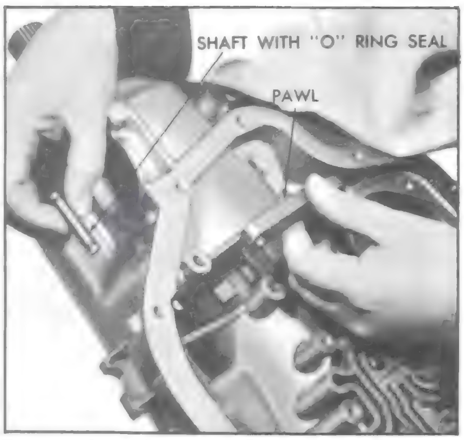


Figure 5-531

5-12 REMOVAL OF REAR OIL SEAL AND EXTENSION HOUSING

1. If necessary to replace, pry the rear oil seal from the extension housing. See Figure 5-532.

2. Remove extension housing to case attaching bolts. See Figure 5-533.

3. Remove the extension housing and extension housing to case seal. See Figure 5-534.

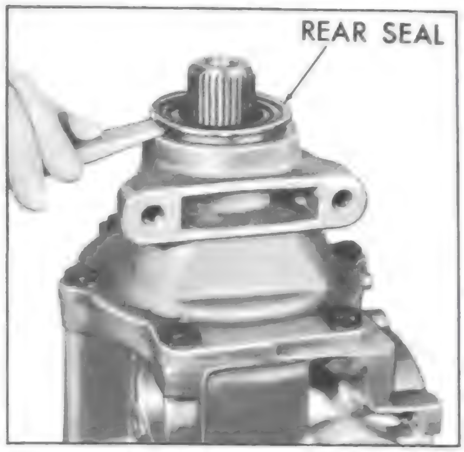


Figure 5-532

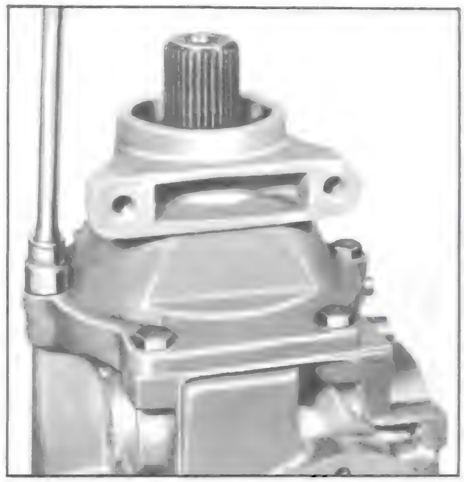


Figure 5-533

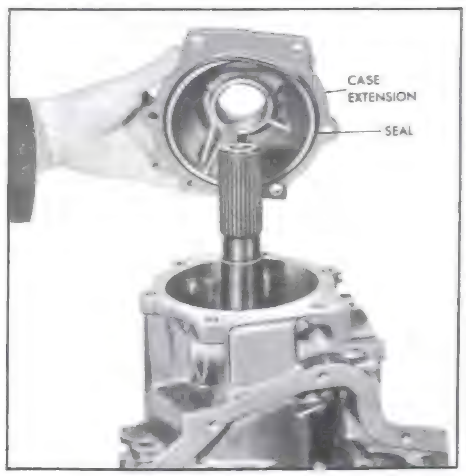


Figure 5-534

5-13 REMOVAL OF OIL PUMP

1. If necessary to replace, pry front seal from pump. See Figure 5-535.

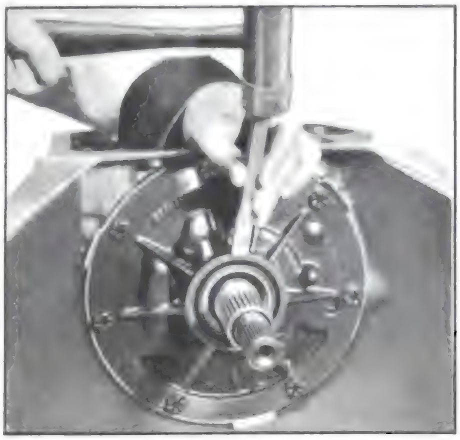


Figure 5-535

2. Remove the pump attaching bolts. See Figure 5-536

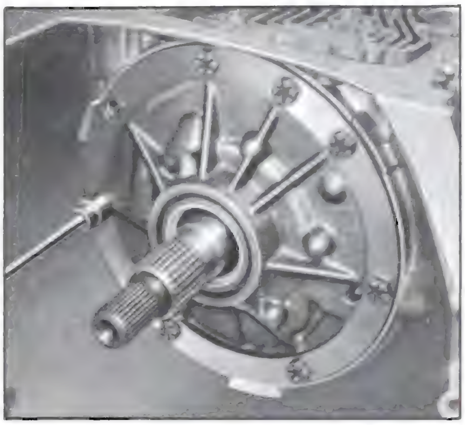


Figure 5-536

3. Install 5/16-18 threaded slide hammers, J-7004 or J-6125, into bolt holes in the pump body and remove. See Figure 5-537 pump assembly from case. (See illustration for location of threaded holes.)

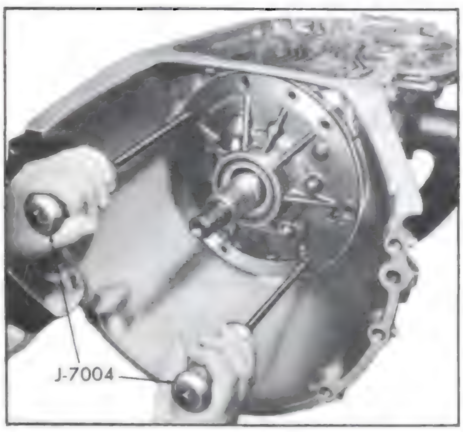


Figure 5-537

4. Remove and discard pump to case seal ring. See Figure 5-538.

Figure 5-538

5. Remove the pump to case gasket.

6. Remove turbine shaft from transmission. See Figure 5-540.

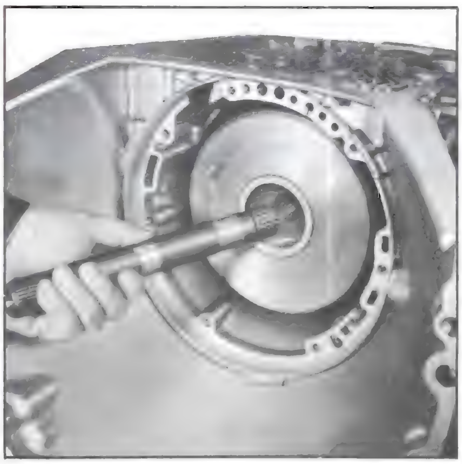


Figure 5-540

7. Remove forward clutch assembly. See Figure 5-541.

8. Remove forward clutch hub to direct clutch housing bronze thrust washer, if it did not come out with forward clutch housing assembly.

9. Remove the direct clutch assembly. See Figure 5-542.

Figure 5-541

Figure 5-542

10. Remove the front band assembly. See Figure 5-543.

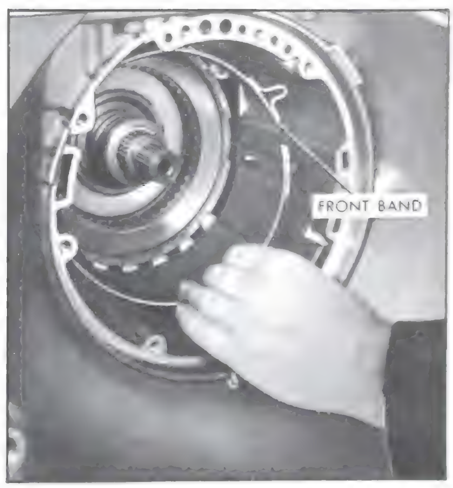


Figure 5-543

11. Remove the sun gear shaft, See Figure 5-544.

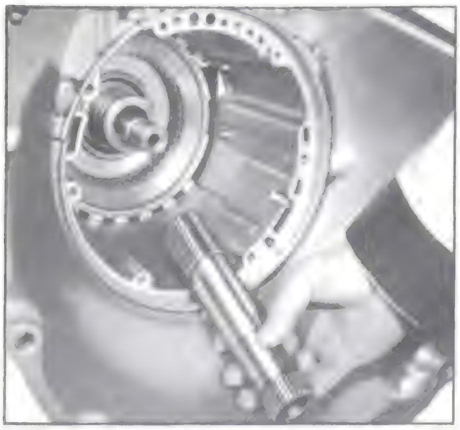


Figure 5-544

12. Remove the case center support to case bolt and center support locating screw. See Figure 5-544A.

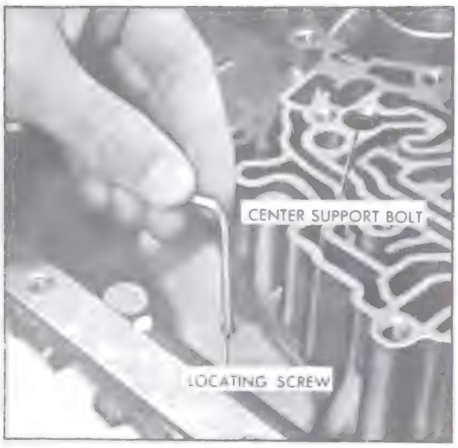


Figure 5-544A

13. Remove the intermediate clutch backing plate to case snap ring. See Figure 5-545.

Figure 5-545

14. Remove the intermediate clutch backing plate, 3 composition, and 3 steel clutch plates. See Figure 5-546.

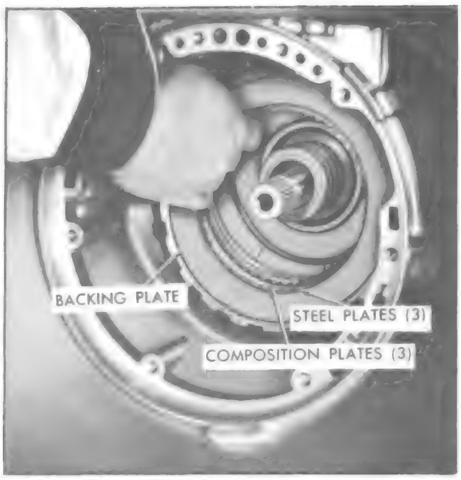


Figure 5-546

15. Remove the center support to case retaining snap ring. See Figure 5-547.

Figure 5-547

16. Remove the entire gear unit assembly by lifting with Gear Assembly Installing and Removing Tool J-21365 with J-7004 slide hammer. See Figure 5-548.

17. Remove the output shaft to case thrust washer from the rear of the output shaft or inside the case. See Figure 5-550.

Figure 5-548

Figure 5-550

18. Place the gear unit assembly with output shaft facing down in hole in work bench. See Figure 5-551.

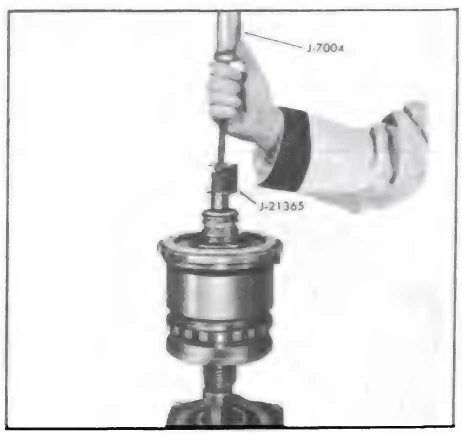


Figure 5-551

19. Remove the rear unit selective washer from the transmission case. See Figure 5-552.

Figure 5-552

20. Remove the rear band assembly. See Figure 5-553.

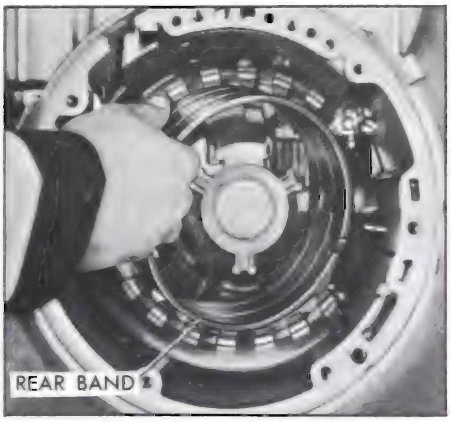


Figure 5-553

5-14 DISASSEMBLY OF GEAR UNIT ASSEMBLY

1. Remove the case center support assembly. See Figure 5-554.

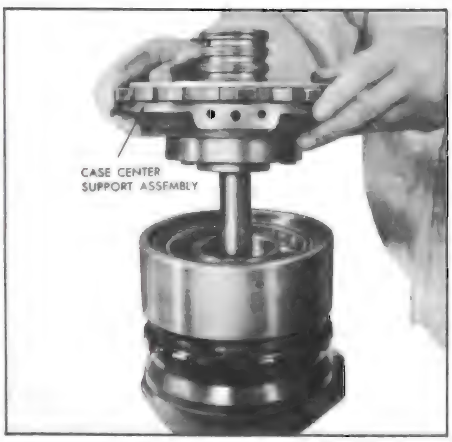


Figure 5-554

2. Remove the center support to reaction carrier bronze thrust washer. See Figure 5-555.

Figure 5-555

3. Remove the center support to sun gear races and thrust bearing. See Figure 5-556.

NOTE: <u>One of the races may have been removed with the center support.</u>

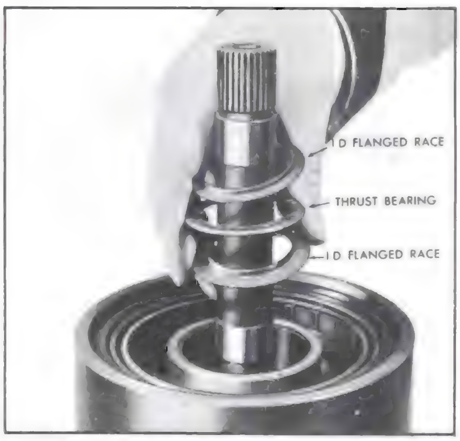


Figure 5-556

4. Remove the reaction carrier and sprag assembly. See Figure 5-557.

5. Remove sun gear. See Figure 5-558.

6. Remove reaction carrier to output carrier thrust washer. See Figure 5-560.

Figure 5-557

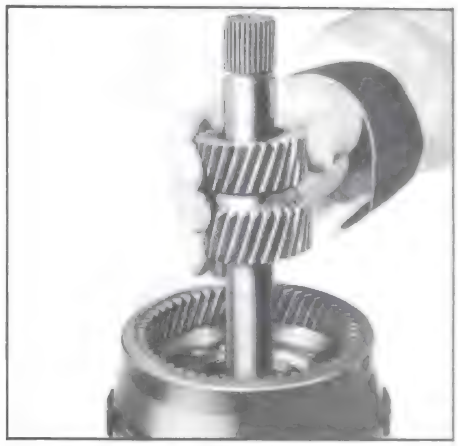


Figure 5-558

Figure 5-560

7. Turn assembly over and place mainshaft in hole in work bench. See Figure 5-561.

8. Remove output shaft to rear carrier snap ring. See Figure 5-562.

Figure 5-561

Figure 5-562

9. Remove output shaft.

NOTE: If replacement of the drive speedo gear is necessary remove in the following manner.

a. Install Speedo Gear Removing Tool, J-21427 and J-9578, on output shaft and remove drive speedo gear. See Figure 5-563.

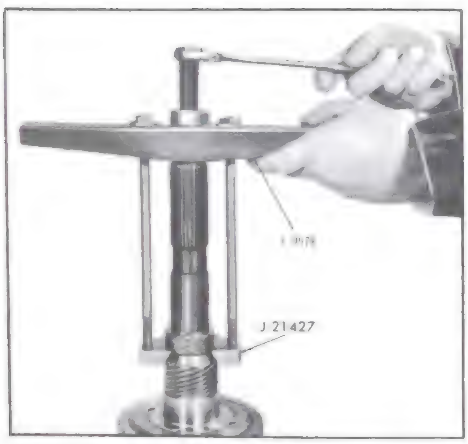


Figure 5-563

b. Install new speedo drive and drive to approximately 5.6" using tool, J-5154. See Figure 5-564.

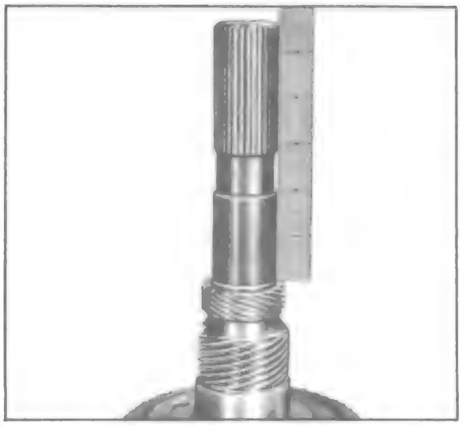


Figure 5-564

10. Remove output shaft to rear internal gear thrust bearing and two (2) races. See Figure 5-565.

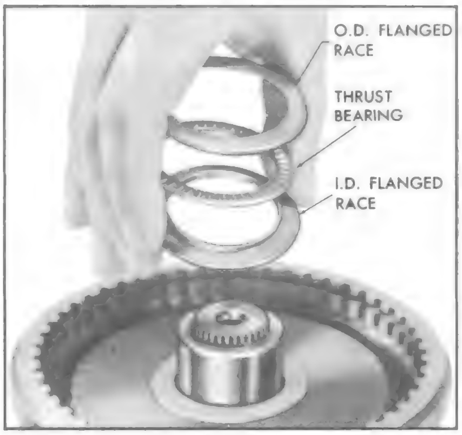


Figure 5-565

11. Remove rear internal gear and mainshaft. See Figure 5-566.

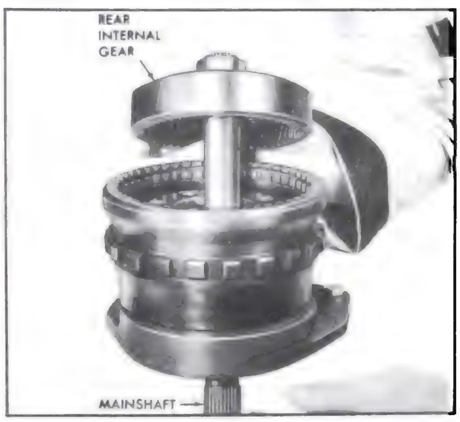


Figure 5-566

12. Remove the rear internal gear to sun gear thrust bearing and two (2) races. See Figure 5-567.

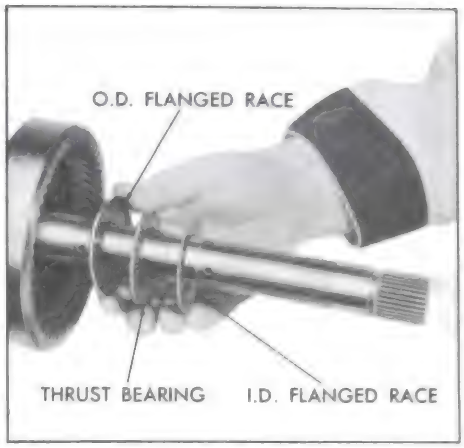


Figure 5-567

13. If necessary, remove the rear internal gear to mainshaft snap ring to remove mainshaft. See Figure 5-568.

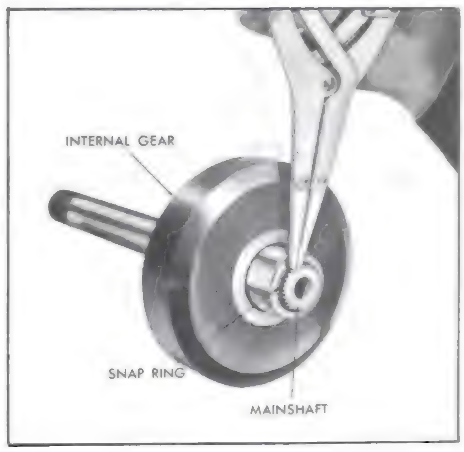


Figure 5-568

5-15 GOVERNOR ASSEMBLY

All components of the governor assembly, with the exception of the driven gear, are of a select fit and each assembly is calibrated. Therefore, the governor will be serviced as an assembly.

a. Inspection

1. Wash governor assembly in cleaning solvent, air dry and blow out all passages.

2. Inspect governor sleeve for nicks, burrs, scoring or galling.

3. Check governor sleeve for free operation in bore of transmission case.

4. Inspect governor valve for nicks, burrs, scoring or galling.

5. Check governor valve for free operation in bore of governor sleeve.

6. Inspect governor driven gear for nicks, burrs or damage.

7. Check governor driven gear for looseness in governor sleeve.

8. Inspect the governor weight springs for distortion or damage.

9. Check the governor weights for free operation in their retainers.

5-16 FRONT SERVO DISASSEMBLY, INSPECTION AND REASSEMBLY

a. Disassembly

1. Place servo assembly in vise so that piston and pin tend to compress spring. See Figure 5-570.

2. Remove piston retaining snap ring using J-4880 pliers.

3. Remove assembly from vise.

4. Remove front servo piston, spring and washer.

5. Remove snap ring and spring retainer from servo pin.

6. Remove oil ring from servo piston.

b. Inspection

1. Inspect servo pin for damaged snap ring groove. See Figure 5-571.

2. Inspect piston for damaged oil ring groove, check freedom of ring in groove.

3. Inspect piston for cracks or porosity.

4. Check fit of servo pin in piston.

c. Reassembly

1. Place small end of spring retainer over tapered end of piston pin.

2. Install retaining snap ring next to spring retainer.

3. Install oil ring on servo piston.

4. Install washer on piston pin end opposite spring retainer.

5. Install spring against spring retainer.

6. Install piston, large end over spring.

7. Place assembly in vise, compress piston pin against piston and install snap ring.

5-17 REAR SERVO DISASSEMBLY, INSPECTION AND REASSEMBLY

a. Disassembly

1. Remove snap ring retaining servo piston to band apply pin. See Figure 5-572.

2. Remove servo piston and washer from band apply pin. See Figure 5-573.

3. Remove second washer from band apply pin.

4. Remove accumulator piston from band apply pin.

5. Remove thrust washer from band apply pin.

6. Remove oil seal from servo piston.

7. Remove oil ring from accumulator piston.

b. Inspection

1. Inspect freedom of accumulator ring in piston.

2. Inspect fit of band apply pin in each piston.

3. Inspect band apply pin for scores, cracks, and opening of drilled passages.

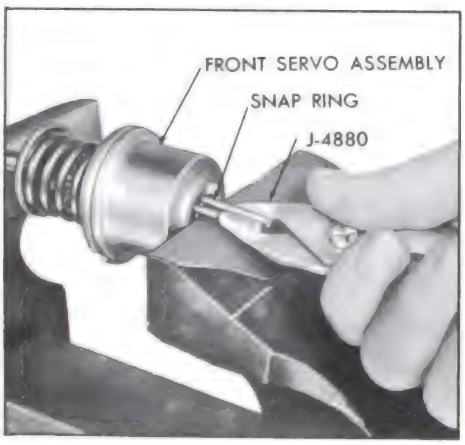


Figure 5-570

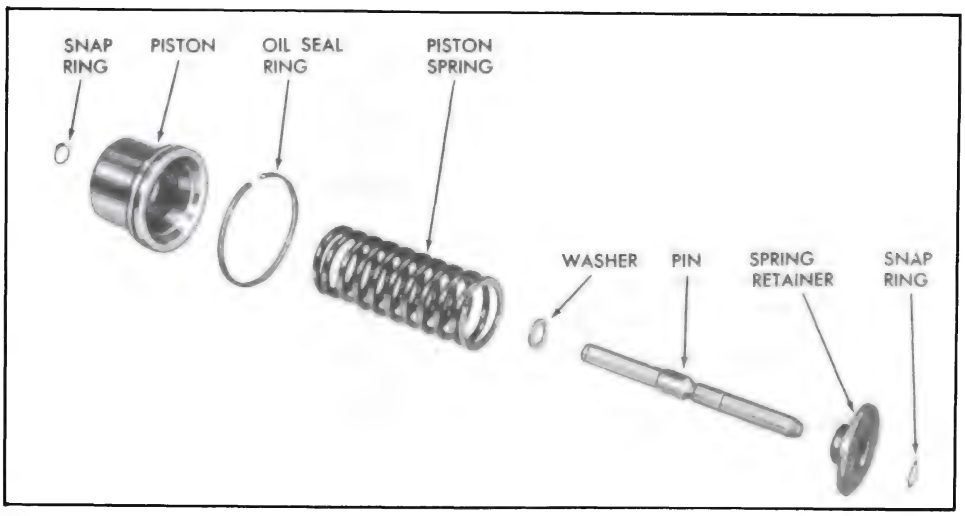


Figure 5-571

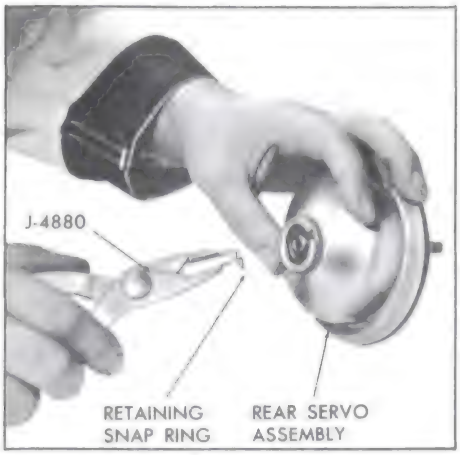


Figure 5-572

4. Inspect accumulator piston for open bleed passage.

5. Inspect band apply pin for proper identification as determined by pin selection check.

c. Reassembly

1. Install ring on accumulator piston.
2. Install seal on servo piston.
3. Install washer with large I.D. over piston pin.
4. Install accumulator piston, cupped end first, over band apply pin.
5. Install flat washer over band apply pin.
6. Install servo piston, large end first, over band apply pin.
7. Install third washer and snap ring.

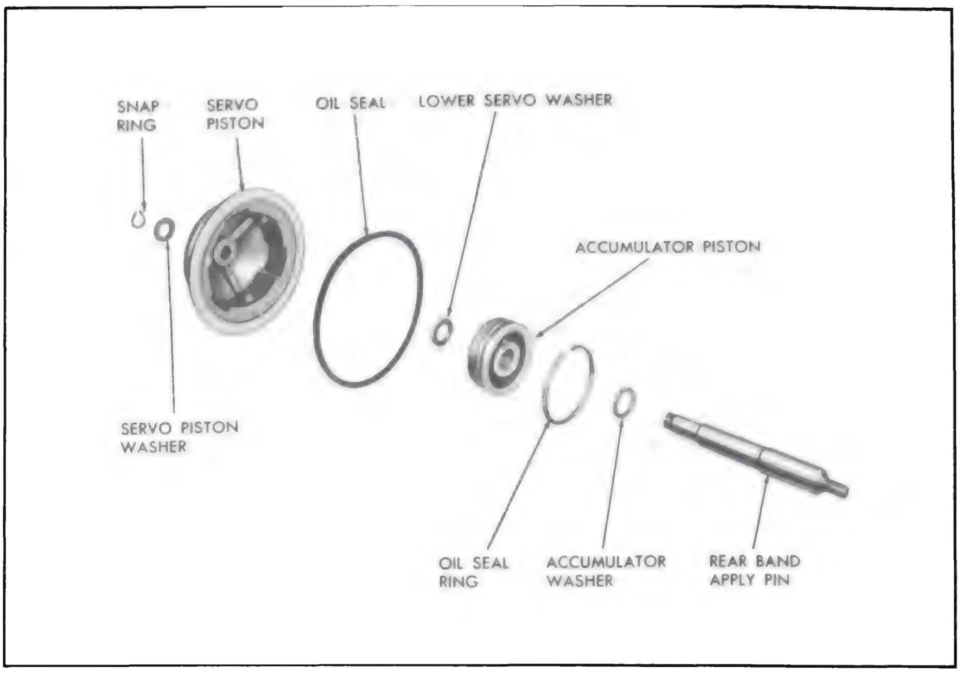


Figure 5-573

5-18 CONTROL VALVE ASSEMBLY, DISASSEMBLY, INSPECTION AND REASSEMBLY

a. Disassembly

1. Position control valve assembly with cored face up and servo pocket nearest operator.

2. Remove manual valve from upper bore.

3. On the right side, next bore, remove the retaining pin, 1-2 bushing, 1-2 modulator valve and 1-2 spring.

4. Remove the 1-2 shift valve.

5. From the next bore remove the retaining pin and 2-3 bushing, 2-3 modulator valve and 2-3 spring.

6. Remove the 2-3 shift valve.

7. From the next bore remove the retaining pin, bore plug, 3-2 spring and valve.

8. At the other end of the assembly, top bore, remove the retaining pin and bore plug.

9. Remove the detent valve, detent regulator valve, spring and spacer.

10. In the next bore, check the operation of the 1-2 accumulator valve by moving the valve against the spring.

NOTE: <u>The 1-2 accumulator valve is factory adjusted.</u>

11. If removal is necessary, back out adjusting screw <u>EXACTLY FOUR TURNS.</u> Remove bore plug, spring and 1-2 accumulator valve. See Figure 5-575.

b. Inspection

1. Inspect all valves for scoring, cracks and free movement in their respective bores.
2. Inspect the bushing for cracks, scratches or distortion.
3. Inspect the body for cracks, or scored bores.

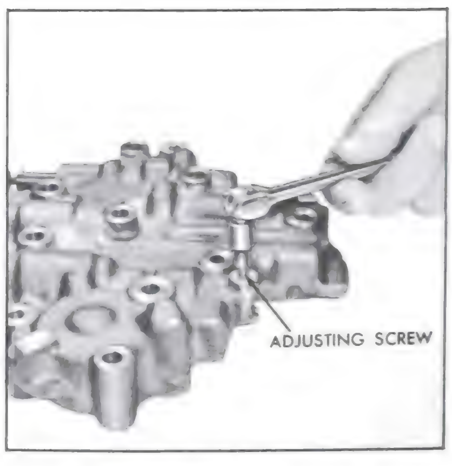


Figure 5-575

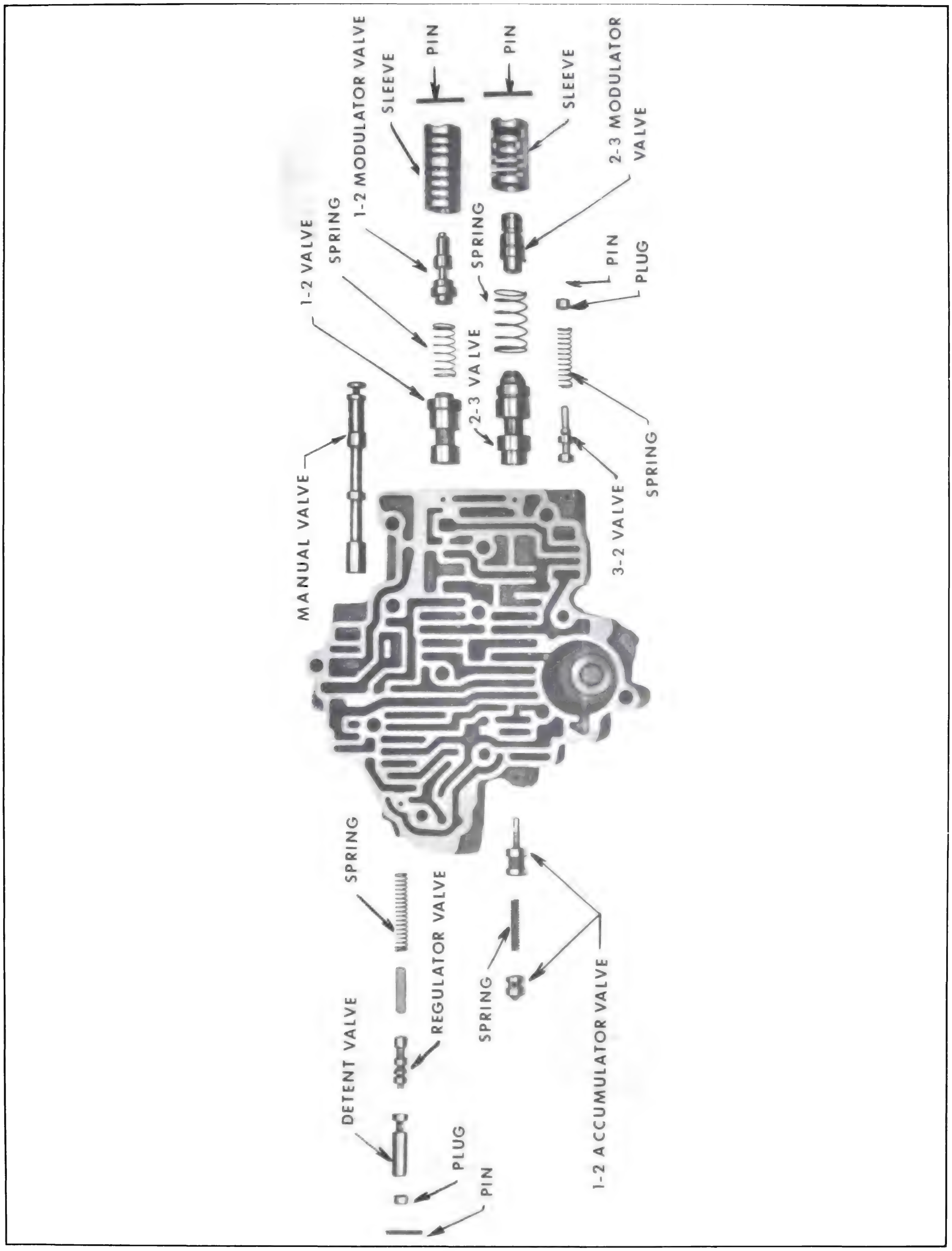

1-2 MODULATOR VALVE
SLEEVE
PIN
PIN
SLEEVE
2-3 MODULATOR VALVE
1-2 VALVE
SPRING
SPRING
PIN
PLUG
2-3 VALVE
MANUAL VALVE
SPRING
3-2 VALVE
SPRING
REGULATOR VALVE
DETENT VALVE
SPRING
1-2 ACCUMULATOR VALVE
PLUG
PIN

Figure 5-574

4. Check all springs for distortion or collapsed coils.

c. Reassembly

1. If the 1-2 accumulator valve was removed, install in lower left bore, small end first.

2. Install 1-2 accumulator spring.

3. Install bore plug over spring, compress bore plug, and tighten adjusting screw EXACTLY FOUR TURNS. See Figure 5-576.

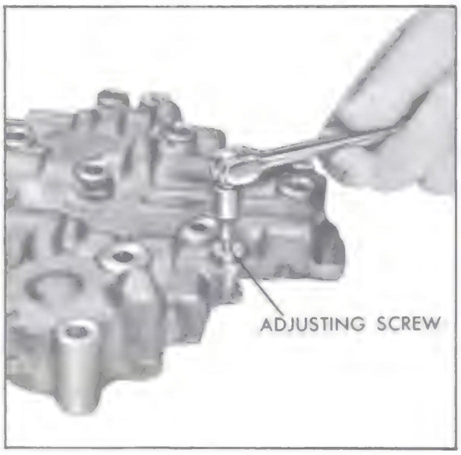


Figure 5-576

4. In the next bore up, install the detent spring and spacer.

5. Install the detent regulator valve as shown in Figure 5-574.

6. Install the detent valve, small land first.

7. Install the bore plug (hole out) and retaining pin.

8. In the lower right hand bore, install the 3-2 valve, stem out.

9. Install the 3-2 spring, bore plug (hole out) and retaining pin.

10. In the next bore up, install the 2-3 shift valve, and spring, straight land first.

11. Install the 2-3 modulator valve into the bushing and install both parts into the valve bore.

12. Compress the bushing against the spring and install the retaining pin.

13. In the next bore, install the 1-2 shift valve, small end first, and install the 1-2 spring.

14. Install the 1-2 modulator valve into the bushing and install both parts into the valve bore.

15. Compress the bushing against the spring and install the retaining pin.

16. Install the manual valve with detent pin groove to the right.

5-19 OIL PUMP DISASSEMBLY, INSPECTION AND REASSEMBLY OF OIL PUMP

a. Disassembly

1. Place pump assembly in hole in bench.

2. Compress the regulator boost valve bushing against the pressure regulator spring and remove the snap ring, using J-5403 pliers. See Figure 5-577.

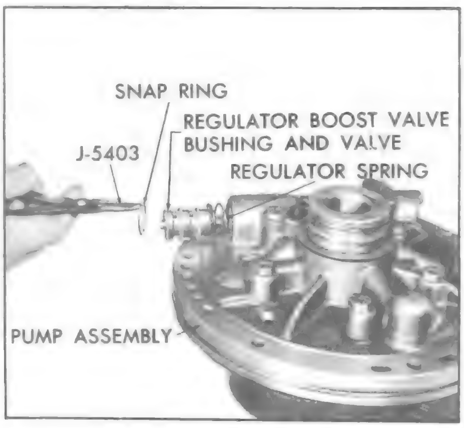


Figure 5-577

3. Remove the regulator boost valve bushing and valve.

4. Remove the pressure regulator spring.

5. Remove the regulator valve, spring retainer and spacer(s), if present. See Figure 5-578.

6. Remove the pump cover to body attaching bolts. See Figure 5-580.

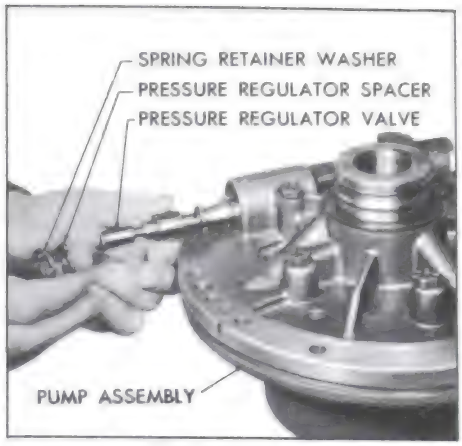


Figure 5-578

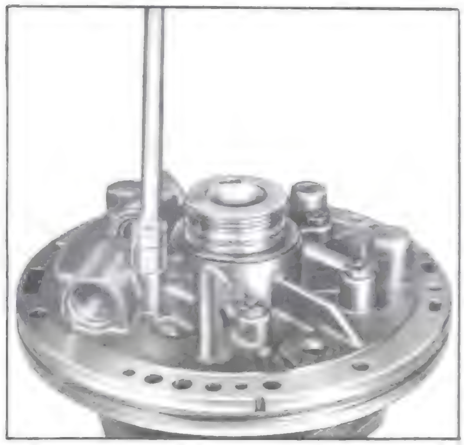


Figure 5-580

7. Remove pump cover from body. See Figure 5-581.

Figure 5-581

8. Remove the retaining pin and bore plug from the pressure regulator bore. See Figure 5-582.

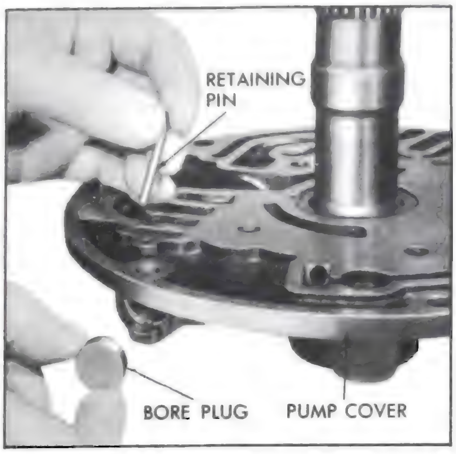


Figure 5-582

9. Remove the hook type oil rings from the pump cover. See Figure 5-583.

Figure 5-583

10. Remove the pump to forward clutch housing selective washer (fiber).

NOTE: Do not remove the cooler by-pass seats, unless replacement of the seats, valves or springs is necessary.

11. If necessary, remove the by-pass valve seats using tool J-21361, attached to a slide hammer, J-6125, or J-7004. See Figure 5-584.

12. Remove the by-pass valves and springs.

13. With pencil lead mark drive and driven gears for reassembly and remove drive. See Figure 5-585.

Figure 5-584

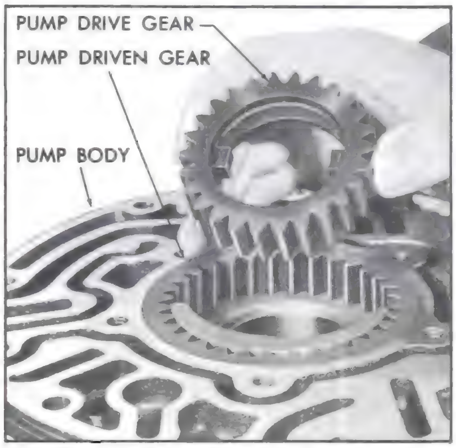


Figure 5-585

14. Remove driven gear from pump body. See Figure 5-585A.

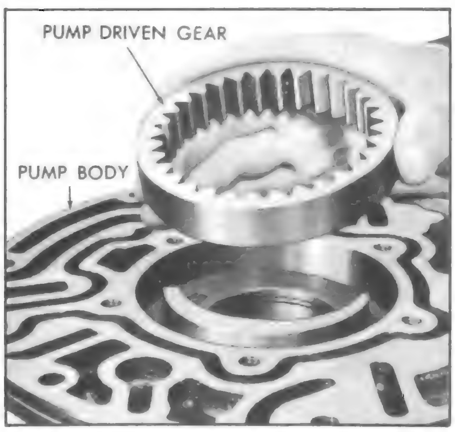


Figure 5-585A

b. Inspection of Pump Body and Pump Cover

1. Inspect the gear pocket and crescent for scoring, galling or other damage. See Figure 5-586.

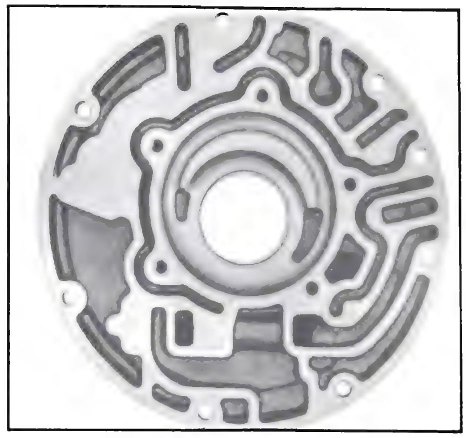


Figure 5-586

2. Place pump gears in pump and check the following clearances while holding each gear towards the crescent.

a. Driven gear O.D. to body clearance. Clearance should be .0045"-.0011". See Figure 5-587.

Figure 5-587

b. Driven gear I.D. to crescent clearance. Clearance should be 000-.0052. See Figure 5-588.

c. Drive gear to crescent .004-.019. See Figure 5-590.

d. Pump body face to gear face clearance. Clearance should be .0008"-.0015". See Figure 5-591.

3. Check face of pump body for scores or nicks.

4. Check oil passages.

Figure 5-588

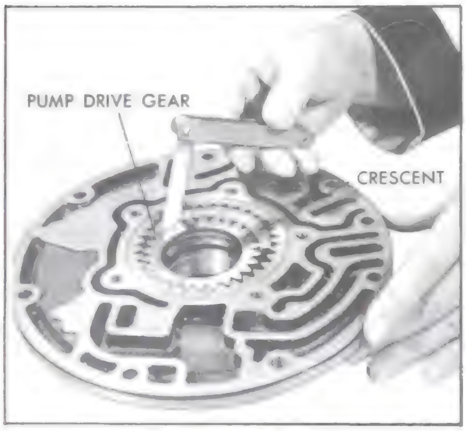


Figure 5-590

Figure 5-591

5. Check for damaged cover bolt attaching threads.

6. Check for overall flatness of pump body face.

7. Check bushing for scores or nicks.

8. Inspect the pump attaching bolt seals for damage, replace if necessary.

9. Inspect pump cover face for over all flatness. See Figure 5-592.

10. Check for scores or chips in pressure regulator bore.

11. Check that all passages are open and not interconnected.

Figure 5-592

12. Check for scoring or damage at pump gear face.

13. Inspect stator shaft for damaged splines, or scored bushings. If replacement of bushing is necessary proceed as follows:

a. Thread J-8647-1 into stator shaft bushing. Thread slide hammer J-2619 into remover. Clamp slide hammer handle into vise. Grasp stator shaft and remove.

b. Using Installer J-21465-3 install bushing.

14. Inspect oil ring grooves for damage or wear.

15. Inspect cooler by-pass valves for free operation and sealing qualities.

16. Inspect selective washer thrust face for wear or damage.

17. Inspect pressure regulator and boost valve for free operation.

c. Reassembly

1. Install the drive and driven pump gears into the pump body with alignment marks up. See Figures 5-593 and 5-593A.

NOTE: The drive gear with drive tangs up.

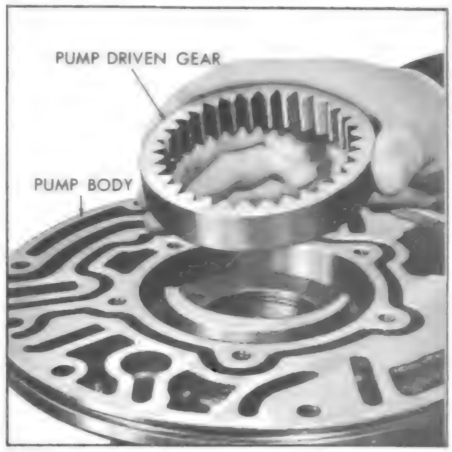


Figure 5-593

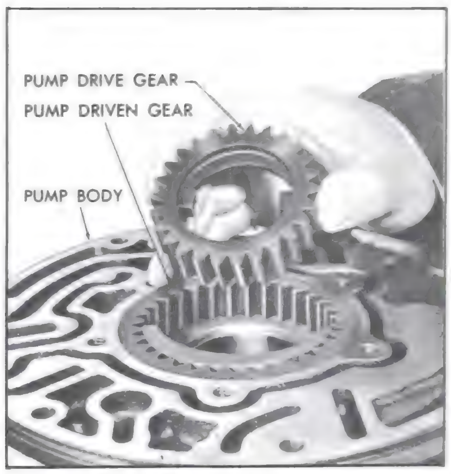


Figure 5-593A

2. Install the pressure regulator spring spacer(s) if required, retainer and spring into the pressure regulator bore.

3. Install the pressure regulator valve from opposite end of bore, stem end first.

4. Install the boost valve into the bushing, stem end out, and install both parts into the pump cover by compressing the bushing against the spring.

5. Install the retaining snap ring.

6. Install the pressure regulator valve bore plug and retaining pin into opposite end of bore. See Figure 5-594.

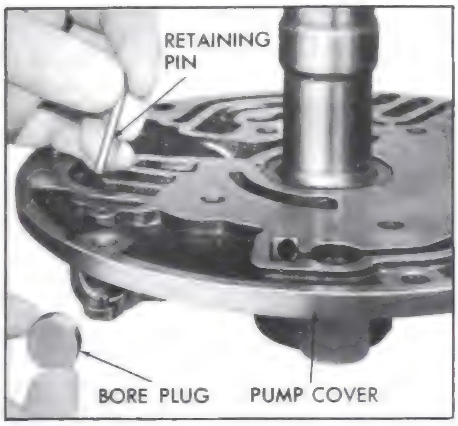


Figure 5-594

7. Install the previously selected front unit selective thrust washer (fiber) over the pump cover delivery sleeve. See Figure 5-595.

Figure 5-595

8. Install two (2) hook type oil seal rings.

9. If removed, install by-pass valve spring (large end first) valve and seat, using J-21360, drive the seat to the stop. See Figure 5-596.

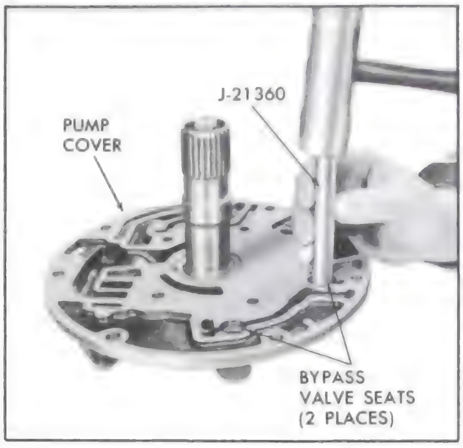


Figure 5-596

10. Assemble pump cover to pump body with attaching bolts. See Figure 5-597.

NOTE: Leave the bolts one turn loose at this time.

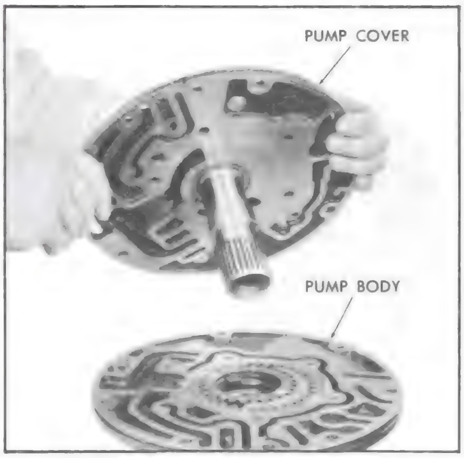


Figure 5-597

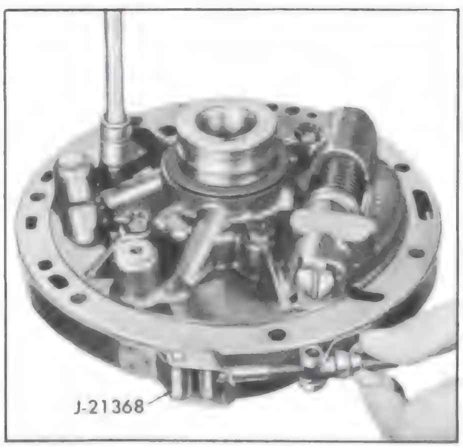


Figure 5-598

11. Place pump aligning strap, J-21368, over pump body and cover, and tighten tool. See Figure 5-598.

12. Tighten pump cover bolts.

13. Install the pump to case "O" ring seal.

5-20 FORWARD CLUTCH DISASSEMBLY, INSPECTION, AND REASSEMBLY

a. Disassembly

1. Remove the forward clutch housing to direct clutch hub snap ring. See Figure 5-600.

Figure 5-600

2. Remove the direct clutch hub. See Figure 5-601.

Figure 5-601

3. Remove the forward clutch hub and thrust washers. See Figure 5-602.

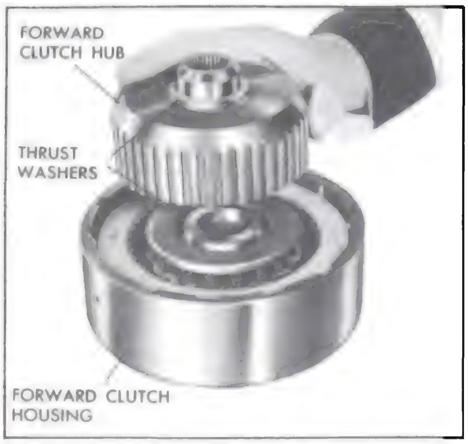


Figure 5-602

4. Remove five (5) composition and five (5) steel clutch plates. See Figure 5-603.

Figure 5-603

5. Using J-2590 clutch spring compressor, compress the spring retainer and remove the snap ring. See Figure 5-604.

6. Remove the tools, snap ring, spring retainer and sixteen clutch release springs. See Figure 5-605.

7. Remove the clutch piston. See Figure 5-606.

8. Remove the inner and outer clutch piston seals. See Figure 5-607.

9. Remove the center piston seal from the forward clutch housing. See Figure 5-608.

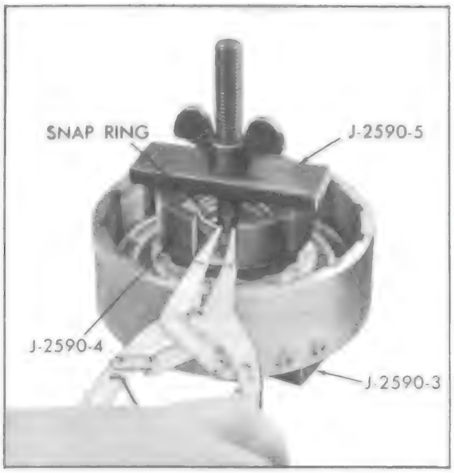


Figure 5-604

Figure 5-605

Figure 5-606

Figure 5-607

Figure 5-608

b. Inspection

1. Inspect the drive and driven clutch plates for signs of burning, scoring, or wear. See Figure 5-611.

2. Inspect sixteen springs for collapsed coils or signs of distortion.

3. Inspect the clutch hubs for worn splines, proper lubrication holes, thrust faces.

4. Inspect the piston for cracks.

5. Inspect the clutch housing for wear, scoring, open oil passages and free operation of the ball check.

c. Reassembly

1. Place new inner, and outer oil seals on clutch piston, lips

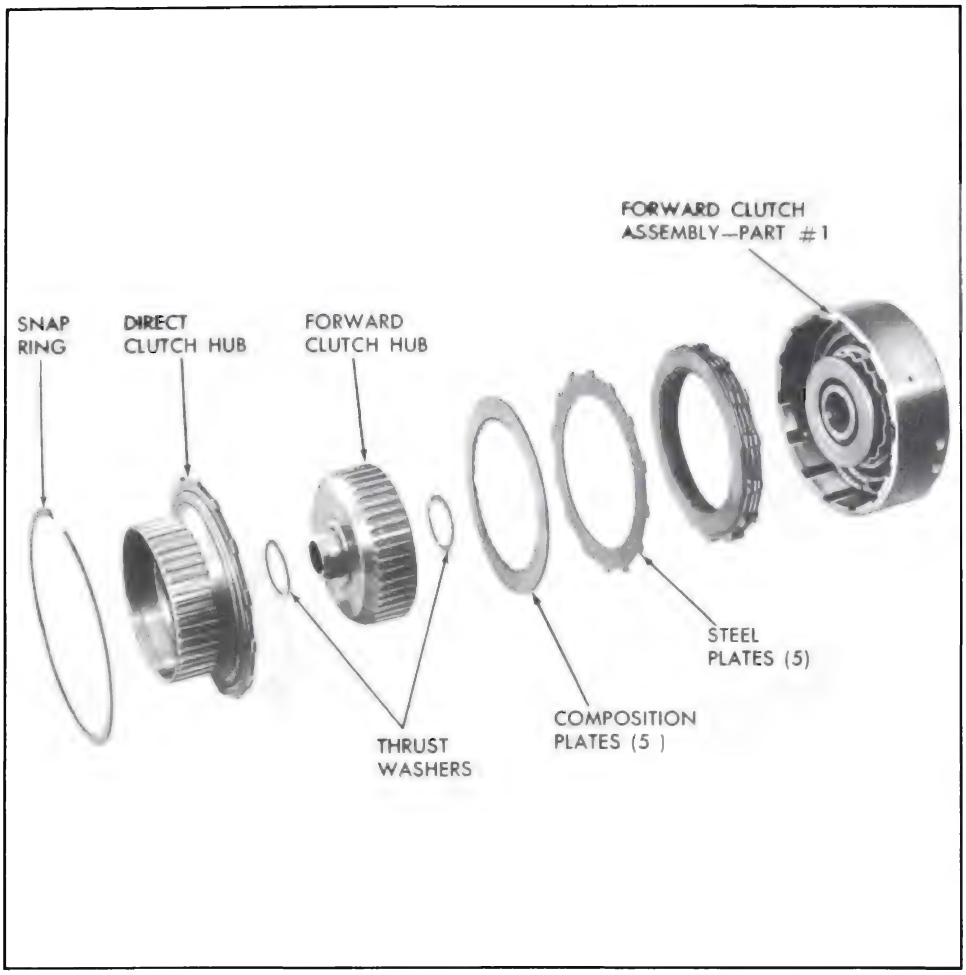


Figure 5-611

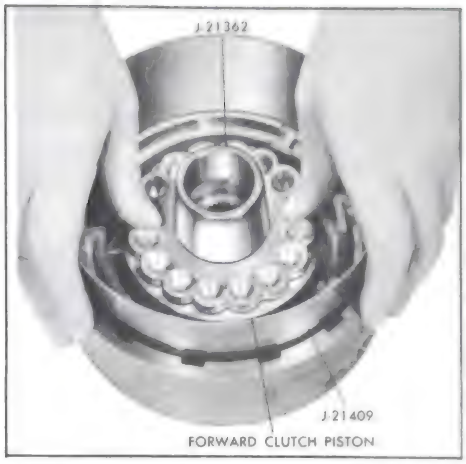


Figure 5-614

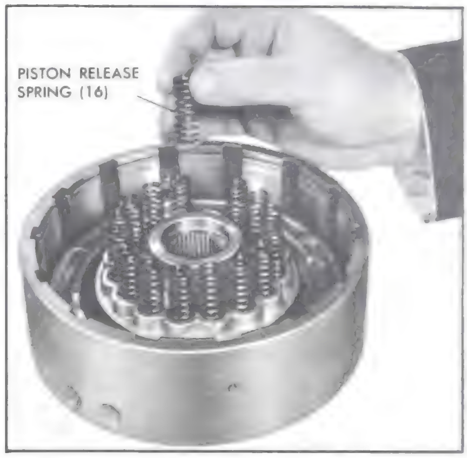


Figure 5-615

face away from spring pockets. See Figure 5-612.

2. Place a new center seal on the clutch housing, lip faces up. See Figure 5-613.

3. Place seal protector tool J-21362, over clutch hub and install outer clutch piston seal protector J-21409, into clutch drum and install piston. See Figure 5-614.

4. Install clutch release springs into pockets in piston. See Figure 5-615.

5. Place spring retainer and snap ring on springs.

6. Compress springs using clutch compressor tool or J-2590, and install snap ring. See Figure 5-616.

Figure 5-612

Figure 5-613

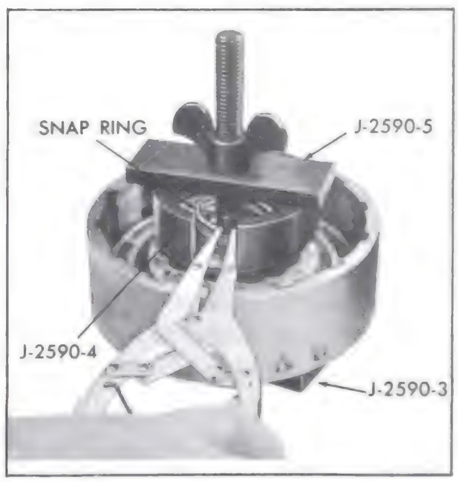


Figure 5-616

7. Oil and install five (5) composition and five (5) steel clutch plates, starting with steel and alternating steel and composition. See Figure 5-617.

Figure 5-617

8. Install the forward clutch hub washers. Retain with petrolatum. See Figure 5-620.

Figure 5-620

9. Place forward clutch hub into forward clutch housing and clutch plates.

10. Install the direct clutch hub and retaining snap ring. See Figure 5-621.

11. Place forward clutch housing on pump delivery sleeve and air check clutch operation. See Figure 5-622.

Figure 5-621

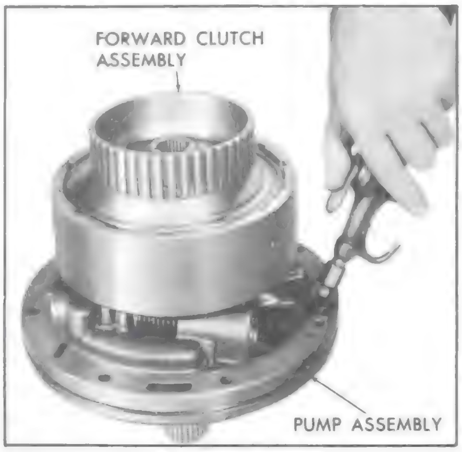


Figure 5-622

5-21 DIRECT CLUTCH AND INTERMEDIATE SPRAG DISASSEMBLY, INSPECTION, AND REASSEMBLY

a. Disassembly

1. Remove sprag retainer snap ring and retainer. See Figure 5-623.

2. Remove sprag outer race, bushings and sprag assembly. See Figure 5-624.

3. Turn unit over and remove backing plate to clutch housing snap ring. See Figure 5-625.

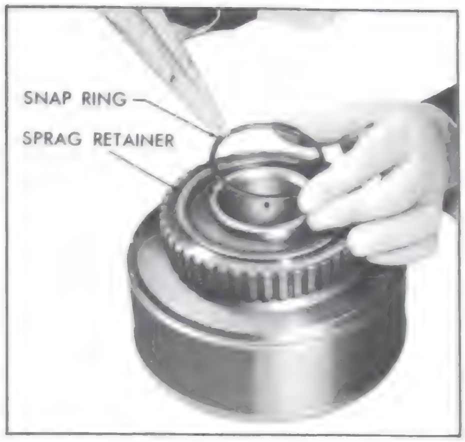


Figure 5-623

Figure 5-624

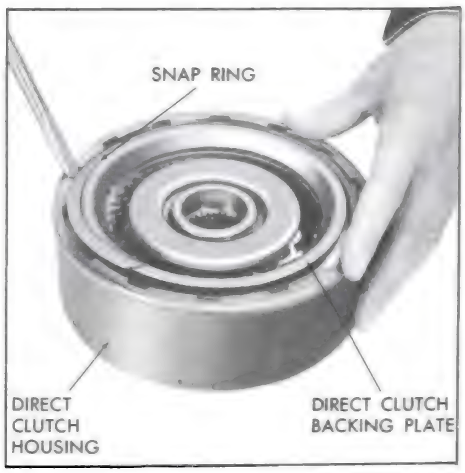


Figure 5-625

4. Remove direct clutch backing plate, (five) 5 composition and (five) 5 steel clutch plates. See Figure 5-626.

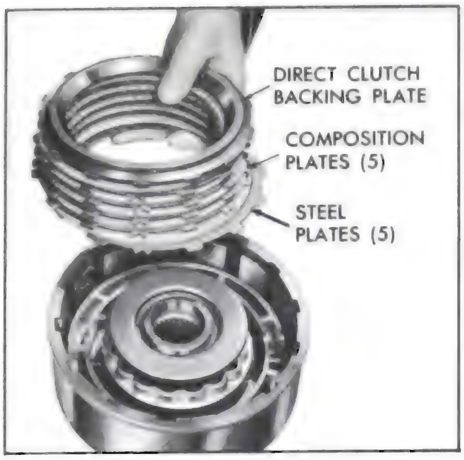


Figure 5-626

5. Using clutch compressor tool J-8765-1 and J-21409 or J-2590, compress spring retainer and remove snap ring. See Figure 5-627.

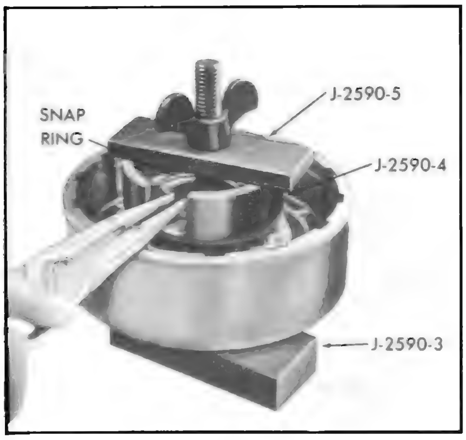


Figure 5-627

6. Remove retainer and sixteen (16) piston release springs. See Figure 5-628.

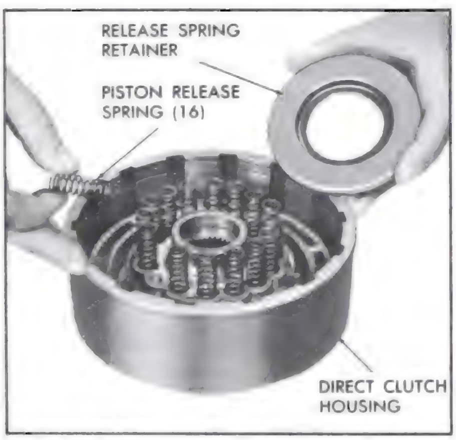


Figure 5-628

7. Remove the direct clutch piston. See Figure 5-630.

Figure 5-630

8. Remove the outer seal from the piston. See Figure 5-631.

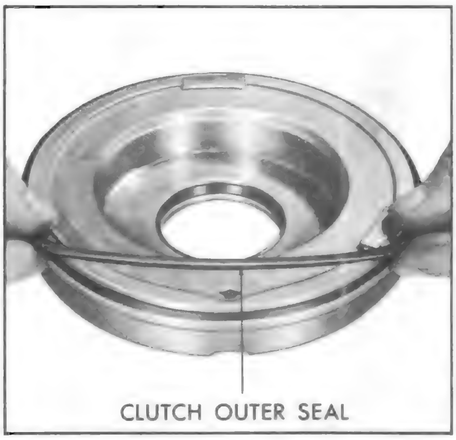


Figure 5-631

9. Remove the inner seal from the piston. See Figure 5-631A.

Figure 5-631A

10. Remove the center piston seal from the direct clutch housing. See Figure 5-632.

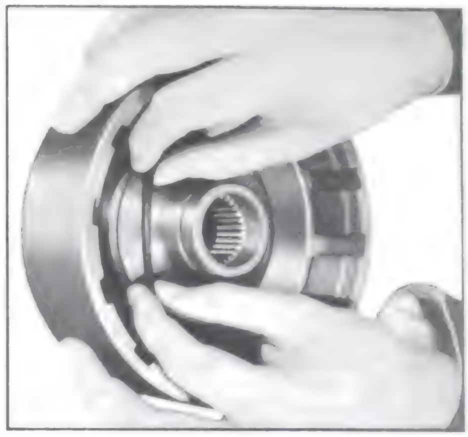


Figure 5-632

b. Inspection

1. Inspect sprag assembly for popped or loose sprags. See Figure 5-633.

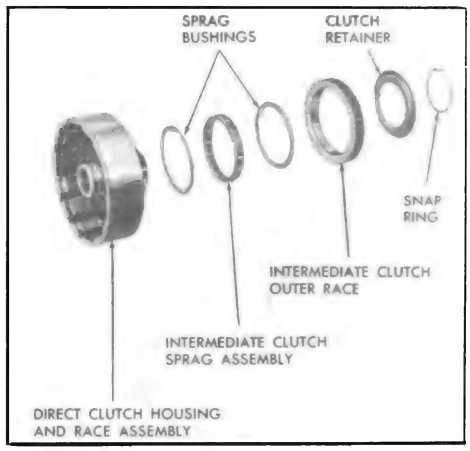


Figure 5-633

2. Inspect sprag bushings for wear or distortion.

3. Inspect the inner and outer races for scratches or wear.

4. Inspect the clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs.

5. Inspect the drive and driven clutch plates for sign of wear or burning.

6. Inspect the backing plate for scratches or other damage.

7. Inspect the clutch piston for cracks and free operation of the ball checks.

c. Assembly

1. Install a new inner clutch piston seal on piston with lips facing away from spring pockets. See Figure 5-634.

Figure 5-634

2. Install a new outer clutch piston seal. See Figure 5-635.

Figure 5-635

3. Install a new center seal on clutch housing with lip of seal facing up. See Figure 5-636.

4. Place seal protectors, tools J-21362 - Inner, J-21409 - Outer, over hub and clutch housing and install clutch piston. See Figure 5-637.

Figure 5-636

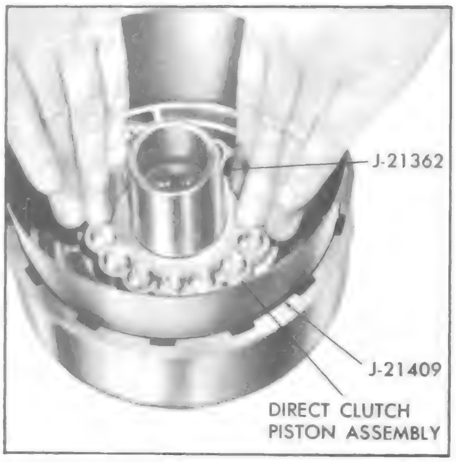


Figure 5-637

5. Install sixteen (16) springs into the piston. See Figure 5-638.

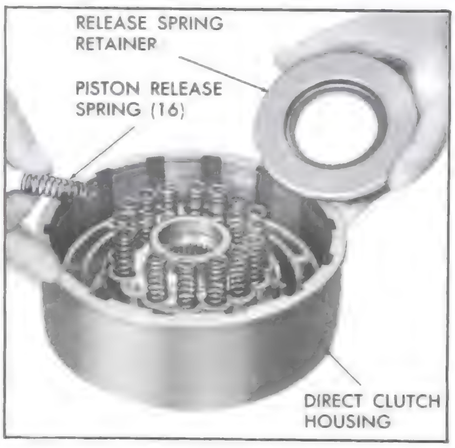


Figure 5-638

6. Place spring retainer and snap ring on retainer.

7. Using clutch compressor tool or J-2590, install snap ring. See Figure 5-639.

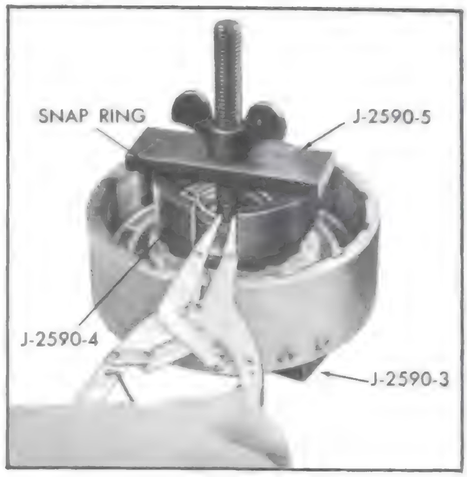


Figure 5-639

8. Install five (5) composition and five (5) steel clutch plates, starting with steel and alternating steel and composition. The steel plates must have the notches in the drive lugs one above the other. See Figure 5-640.

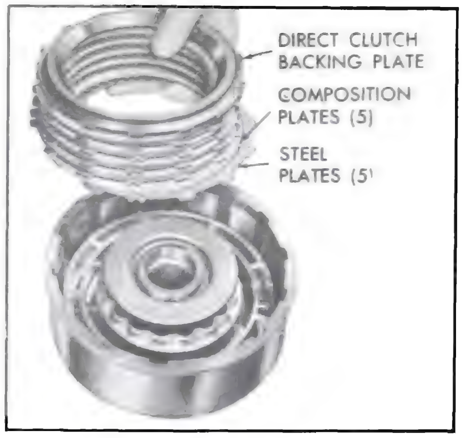


Figure 5-640

9. Install the clutch backing plate.

10. Install the backing plate retaining snap ring. See Figure 5-641.

11. Turn unit over and install one sprag bushing, cup side up, over inner race.

12. Install sprag assembly into outer race.

13. With ridge on inner cage facing down start sprag and outer

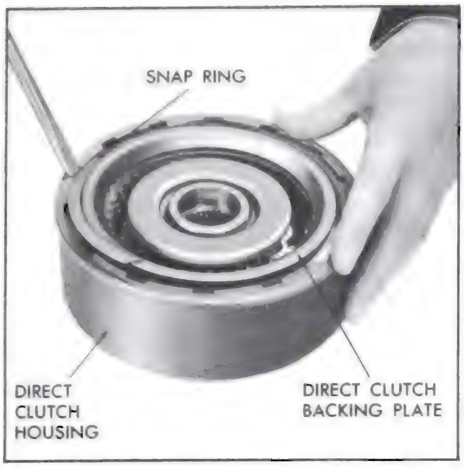


Figure 5-641

race over inner race with clockwise turning motion. See Figure 5-642.

NOTE: Outer race should not turn counterclockwise.

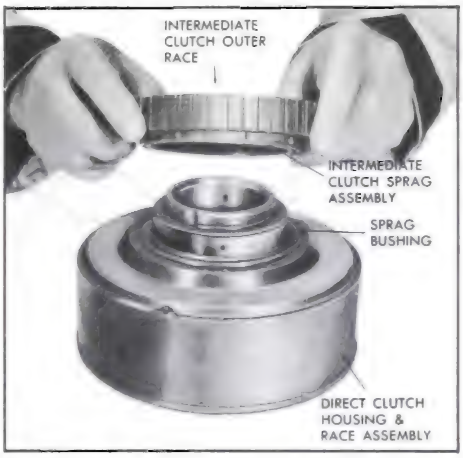


Figure 5-642

14. Install sprag retainer over sprag, cup side down. See Figure 5-643.

Figure 5-643

15. Install sprag retainer and snap ring. See Figure 5-644.

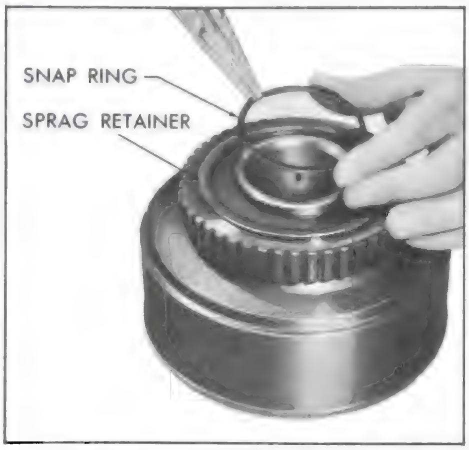


Figure 5-644

16. Place direct clutch assembly over center support and air check operation of direct clutch. See Figure 5-645.

NOTE: If air is applied through reverse passage it will escape from the direct clutch passage. This is normal.

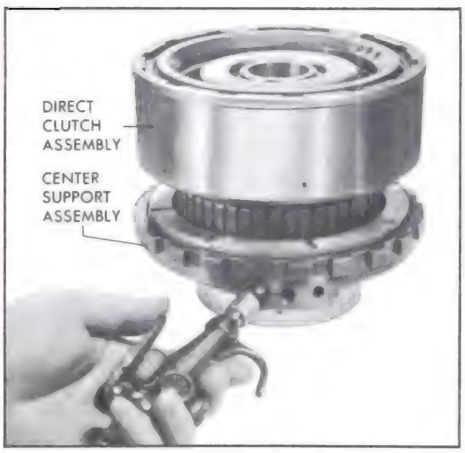


Figure 5-645

5-22 CENTER SUPPORT AND INTERMEDIATE CLUTCH DISASSEMBLY, INSPECTION, AND REASSEMBLY

a. Disassembly

1. Remove four (4) hook type oil seal rings from center support. See Figure 5-646.

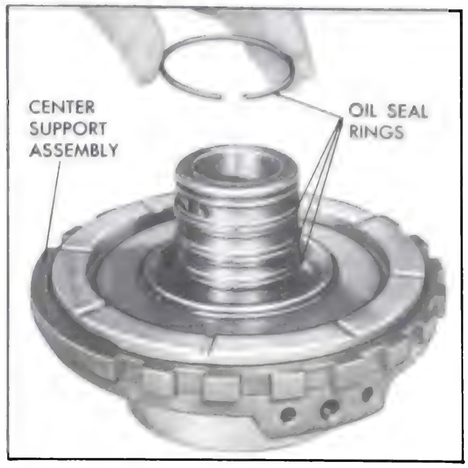


Figure 5-646

2. Using Clutch Compressor J-2590, compress the spring retainer and remove the snap ring. See Figure 5-647.

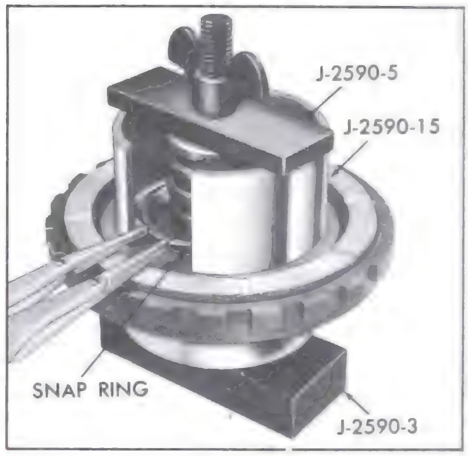


Figure 5-647

3. Remove the spring retainer and twelve (12) clutch release springs. See Figure 5-648.

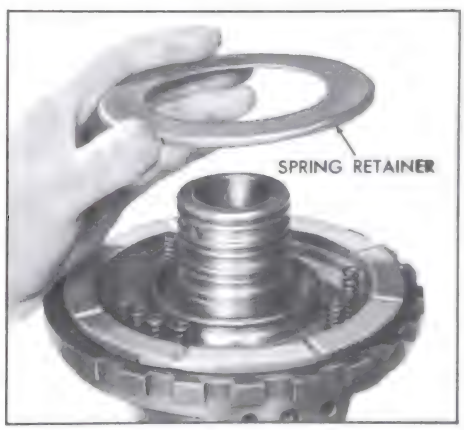


Figure 5-648

4. Remove the intermediate clutch piston. See Figure 5-650.

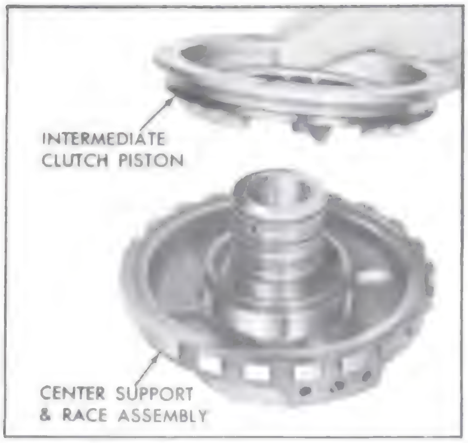


Figure 5-650

5. Remove the inner piston seal. See Figure 5-651.

NOTE: Do not remove the three (3) screws retaining the sprag inner race to the center support.

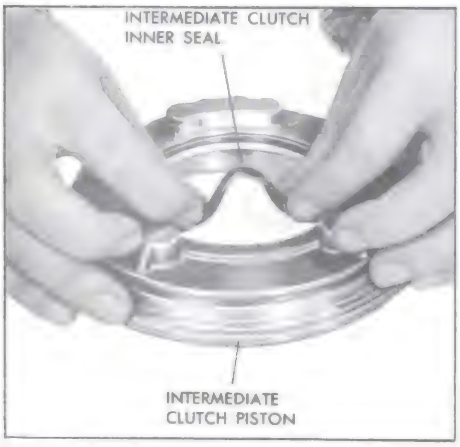


Figure 5-651

Figure 5-651A-

6. Remove the outer piston seal. See Figure 5-651A.

b. Inspection

1. Inspect the sprag inner race for scratches or indentations. Be sure the lubrication hole is open. See Figure 5-652.

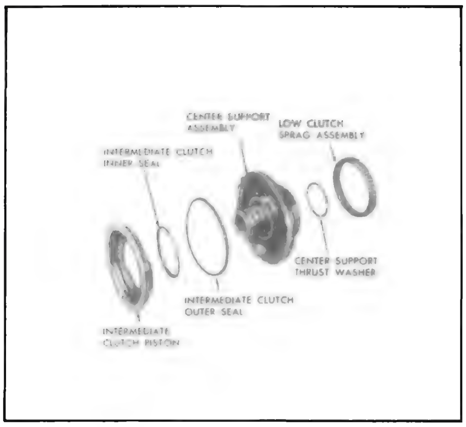


Figure 5-652

2. Inspect the bushing for scoring, wear or galling. If replacement is necessary proceed as follows:

a. Using tool J-21465-6 remove bushing.

b. From sprag side of support install bushing using tool J-21465-6. Install bushing flush to .010 below counterbore.

3. Check the oil ring grooves for damage.

Figure 5-653

4. Air check the oil passages to be sure they are open and not interconnected. See Figure 5-653.

5. Inspect the piston sealing surfaces for scratches.

6. Inspect the piston seal grooves for nicks or other damage.

7. Inspect the piston for cracks or porosity.

8. Inspect the release springs for distortion.

c. Assembly

1. Install new inner seal on the piston with lip of the seal facing away from the spring pocket. See Figure 5-654.

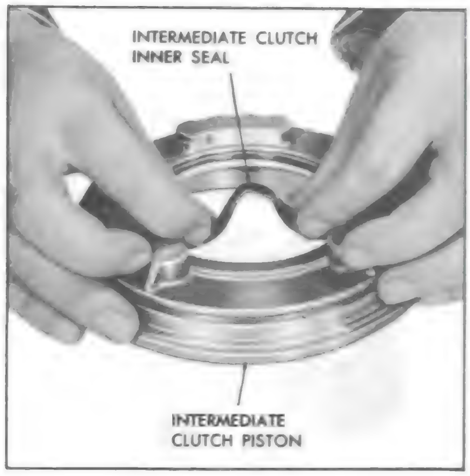


Figure 5-654

2. Install new outer seal. See Figure 5-654A.

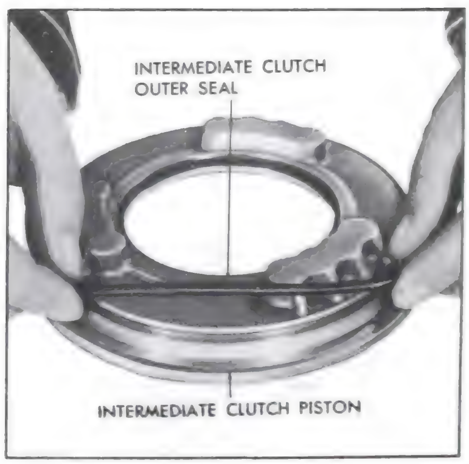


Figure 5-654A

3. Install inner seal protector, tool J-21363, on the center support hub, install the piston. See Figure 5-655.

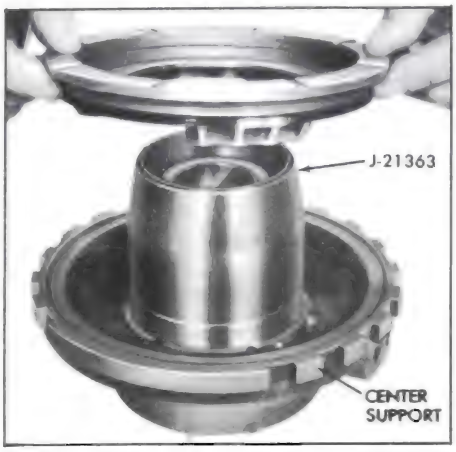


Figure 5-655

4. Install twelve (12) release springs into the piston. See Figure 5-656.

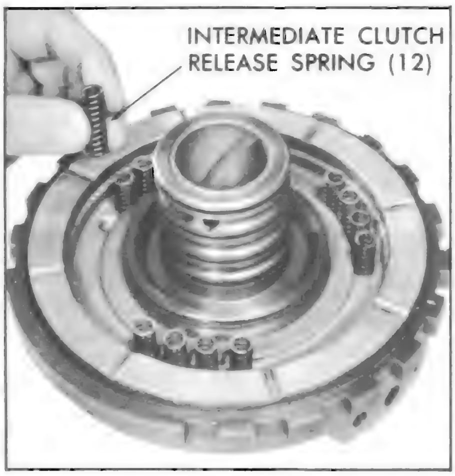


Figure 5-656

5. Place the spring retainer and snap ring over the springs.

6. Using the clutch spring compressor, compress the springs and install the snap ring. See Figure 5-657.

7. Install four (4) hook type oil rings. See Figure 5-658.

8. Air check operation of intermediate clutch piston. See Figure 5-560.

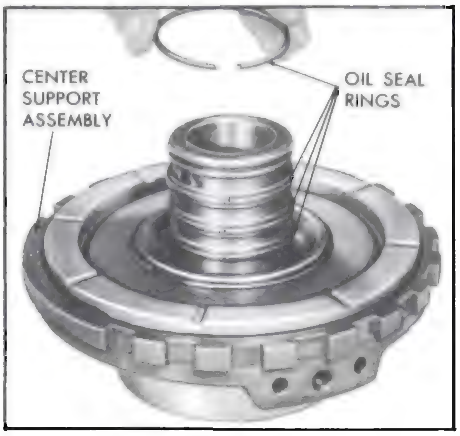


Figure 5-657

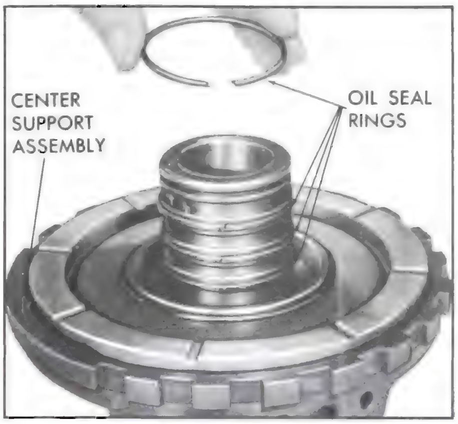


Figure 5-658

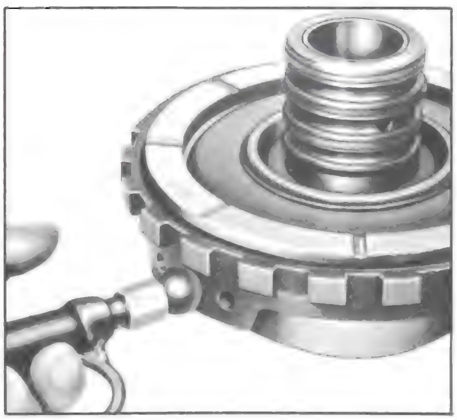


Figure 5-660

5-23 INSPECTION OF REACTION CARRIER, REAR SPRAG AND OUTPUT CARRIER ASSEMBLY

1. Inspect band surface on reaction carrier for signs of burning or scoring.

2. Inspect the sprag outer race for scoring or wear.

3. Inspect the thrust washer surfaces for signs of scoring or wear.

4. Inspect the bushing for damage. If bushing is damaged the reaction carrier must be replaced.

5. Inspect the pinions for damage, rough bearings or excessive tilt.

6. Check pinion end play. Pinion end play should be .009" - .024". See Figure 5-662.

Figure 5-662

7. Inspect the sprag for damaged members.

8. Inspect the sprag cage and retaining spring for damage.

9. Inspect the front internal gear for damaged teeth.

10. Inspect the pinions for damage, rough bearings or excessive tilt.

11. Check pinion end play. Pinion end play should be .009" - .024". See Figure 5-663.

12. Inspect the parking pawl lugs for cracks or damage.

13. Inspect the output locating splines for damage.

Figure 5-563

5-24 PINION REPLACEMENT PROCEDURE

1. Support the carrier assembly on its front face.

2. Using a tapered punch, drive or press the pinions out of the carrier. See Figure 5-664.

Figure 5-664

3. Remove the pinions, thrust washers and roller needle bearings.

4. Inspect the pinion pocket thrust faces for burrs and remove if present.

5. Install nineteen (19) needle bearings into each pinion, using petrolatum to hold the bearings in place. Use a pinion pin as a guide. See Figure 5-665.

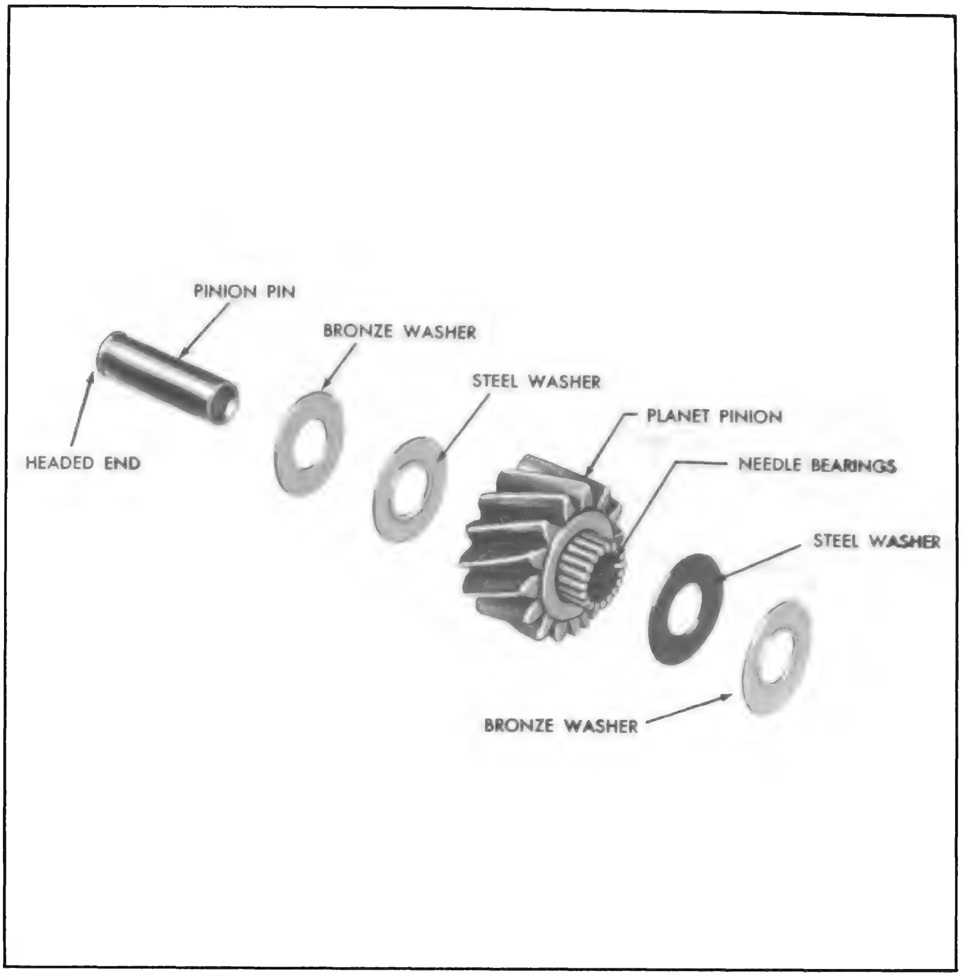


Figure 5-665

6. Place a bronze and steel thrust washer on each side of pinion so steel washer is against pinion, hold them in place with petrolatum.

7. Place the pinion assembly in position in the carrier and install a pilot shaft through the rear face of the assembly to hold the parts in place.

8. Drive a new pinion pin into place while rotating pinion from the front, being sure that the headed end is flush or below the face of the carrier. See Figure 5-666.

9. Place a large punch in a bench vise to be used as an anvil while staking the opposite end of the pinion pin in three places. See Figure 5-667.

NOTE: Both ends of the pinion pins must lie below the face of the carrier or interference may occur.

Figure 5-666

Figure 5-667

5-25 INSPECTION OF OUTPUT SHAFT

a. Output Shaft

1. Inspect the bushing for wear or galling. If replacement is necessary proceed as follows:

a. Thread Tool J-7451-1 into bushing using slide hammer J-2619.

b. Using Tool J-21465-1 install bushing.

2. Inspect the bearing and thrust washer surfaces for damage.

3. Inspect the governor drive gear for rough or damaged teeth.

4. Inspect the splines for damage.

5. Inspect the orificed cup plug in the lubrication passage.

6. Inspect the drive lugs for damage.

b. Inspection of Rear Internal Gear

1. Inspect the gear teeth for damage or wear.

2. Inspect the splines for damage.

3. Inspect the gear for cracks.

c. Inspection of Sun Gear

1. Inspect gear teeth for damage or wear.

2. Inspect splines for damage.

3. Be sure oil lubrication hole is open.

d. Inspection of Sun Gear Shaft

1. Inspect shaft for cracks or splits.

2. Inspect splines for damage.

3. Inspect bushings for scoring or galling.

4. Inspect the ground bushing journals for damage.

5. Be sure the oil lubrication hole is open.

e. Inspection of Turbine Shaft

1. Inspect for open lubrication passages at each end.

2. Inspect the splines for damage.

3. Inspect the ground bushing journals for damage.

4. Inspect the shaft for cracks or distortion.

f. Inspection of Main Shaft

1. Inspect the shaft for cracks or distortion.

2. Inspect the splines for damage.

3. Inspect the ground bushing journals for damage.

4. Inspect the snap ring groove for damage.

5. Inspect the orificed cup plug pressed into one end of the mainshaft. Be sure it is not plugged.

g. Inspection of Front and Rear Bands

1. Inspect the lining for cracks, flaking, burning or looseness. See Figure 5-668.

2. Inspect the bands for cracks or distortion.

3. Inspect the end for damage at the anchor lugs or supply lugs.

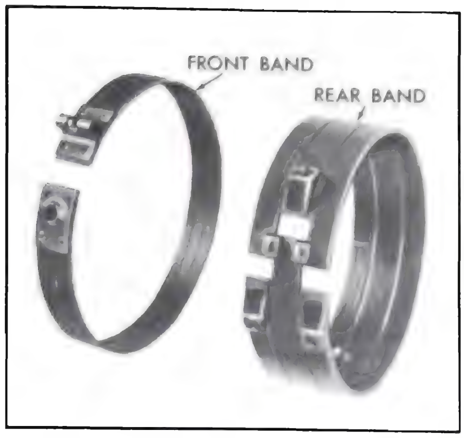


Figure 5-668

h. Inspection of Case Extension

1. Inspect the bushing for excessive wear or damage. If replacement is necessary proceed as follows:

a. Use J-8092 Driver Handle and Tool J-9640 and remove.

b. Using Tool J-9640 install bushing.

2. Inspect the seal ring groove for damage.

3. Inspect the housing for cracks or porosity.

4. Be sure rear seal drain back port is not obstructed.

i. Inspection of Modulator and Valve

1. Inspect the modulator assembly for any signs of bending or distortion. See Figure 5-670.

2. Inspect the "O" ring seal seat for damage.

3. Apply suction to the vacuum tube and check for diaphragm leaks.

4. Inspect the modulator valve for nicks or damage.

5. Check freeness of valve operation in case bore.

6. Check modulator bellows, modulator plunger is under pressure (16 lb.). If bellows is damaged the plunger will have very little pressure.

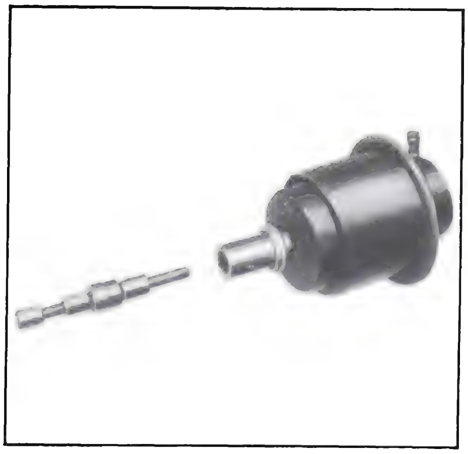


Figure 5-670

j. Inspection of Manual and Parking Linkage

1. Inspect the parking actuator rod for cracks, damaged snap ring groove or broken spring retainer lugs. See Figure 5-671.

2. Inspect the actuator spring for damage.

3. Inspect actuator for a free fit on the actuator rod.

4. Inspect the parking pawl for cracks or wear.

5. Inspect the manual shaft for damaged threads, rough oil seal journal or loose lever.

6. Inspect the inside detent lever for cracks or a loose pin.

7. Inspect the parking pawl shaft for damaged oil seal or retainer grooves.

8. Inspect the parking pawl return spring for deformed coils or ends.

9. Inspect the parking bracket for cracks or wear.

10. Inspect detent roller and spring assembly.

k. Inspection of Case Assembly

1. Inspect case assembly for cracks, porosity or interconnected passages.

2. Check for good retention of band anchor pins.

3. Inspect all threaded holes for thread damage.

4. Inspect the intermediate clutch driven plate lugs for damage or brinneling.

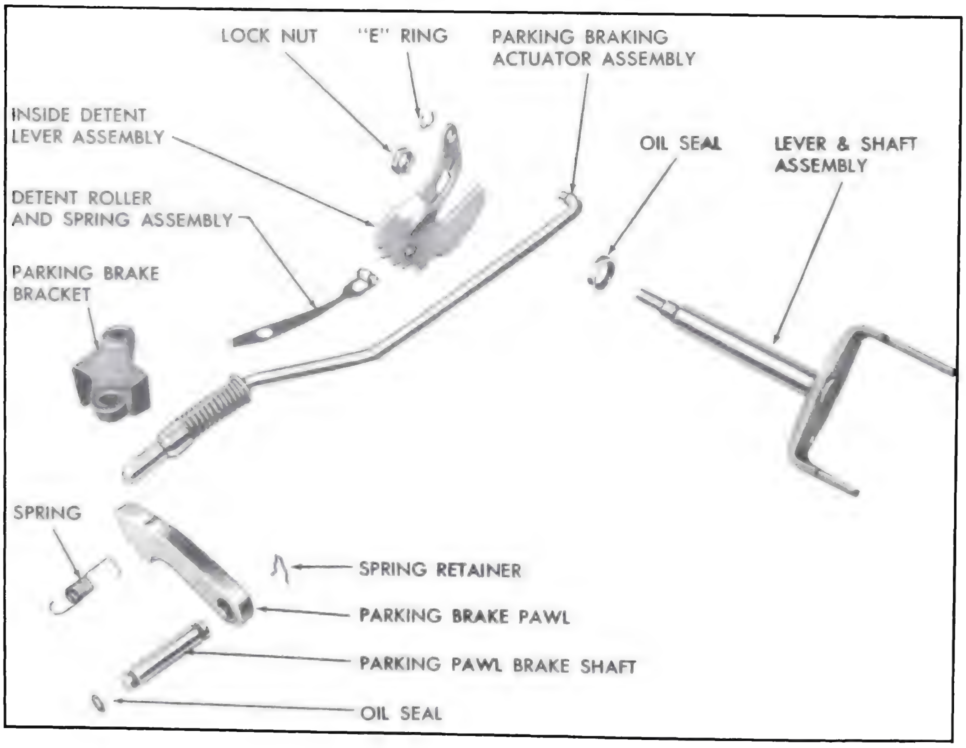


Figure 5-671

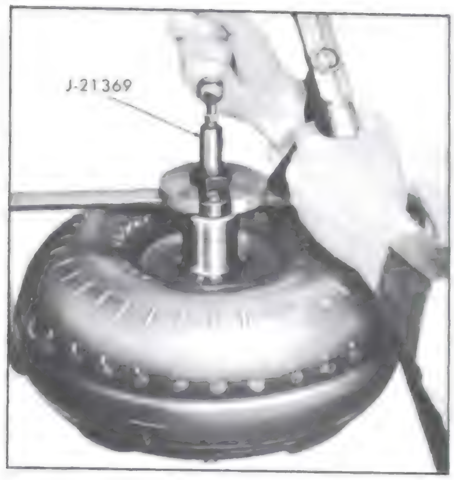


Figure 5-672

5. Inspect the snap ring grooves for damage.

6. Inspect the bore for the governor assembly for scratches or scoring.

7. Inspect the modulator valve bore for scoring or damage.

8. Inspect the cup plug inside the case for good staking and sealing.

l. Inspection of Torque Convertor

1. Check convertor for leaks as follows: (See Figure 5-672.)

a. Install Tool J-21369, and tighten.

b. Fill convertor with air; 80 psi.

c. Submerge in water and check for leaks.

2. Check convertor hub surfaces for signs of scoring or wear.

5-26 ASSEMBLY OF REAR UNIT

1. Install rear internal gear on end of mainshaft having snap ring groove.

2. Install internal gear retaining snap ring. See Figure 5-673.

3. Install the sun gear to internal gear thrust races and bearings

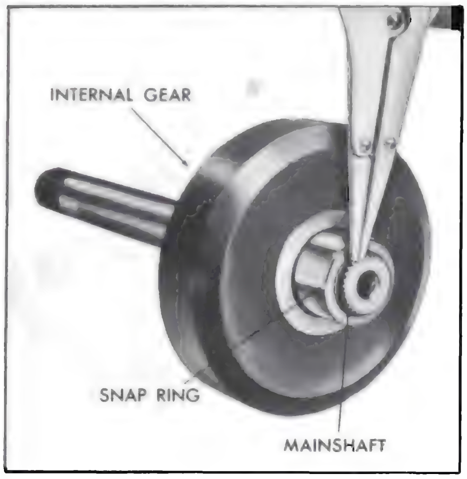


Figure 5-673

against the inner face of the rear internal gear as follows, and retain with petrolatum.

a. Place the large race against the internal gear with flange facing forward or up. See Figure 5-674.

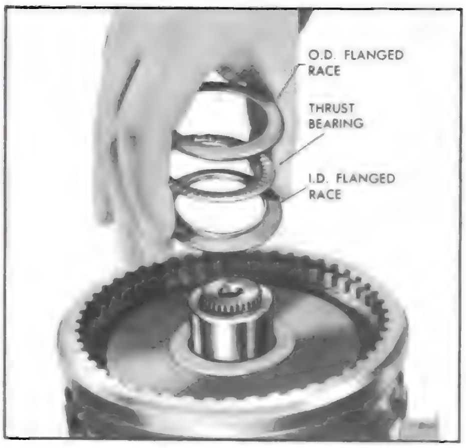


Figure 5-674

b. Place the thrust bearing against the race.

c. Place the small race against the bearing with the inner flange facing into the bearing or down.

4. Install the output carrier over the mainshaft so that the pinions mesh with the rear internal gear.

5. Place the above portion of the "build-up" through hole in bench so that the mainshaft hangs downward.

6. Install the rear internal gear to output shaft thrust races and bearings as follows; and retain with petrolatum. See Figure 5-674.

a. Place the small diameter race against the internal gear with the center flange facing up.

b. Place the bearing on the race.

c. Place the second race on the bearing with the outer flange cupped over the bearing.

7. Install the output shaft into the output carrier assembly. See Figure 5-675.

Figure 5-675

8. Install the output shaft to output carrier snap ring. See Figure 5-676.

Figure 5-676

9. Install output shaft to case thrust washer, tabs in pockets.

10. Turn assembly over and support so that the output shaft hangs downward. See Figure 5-677.

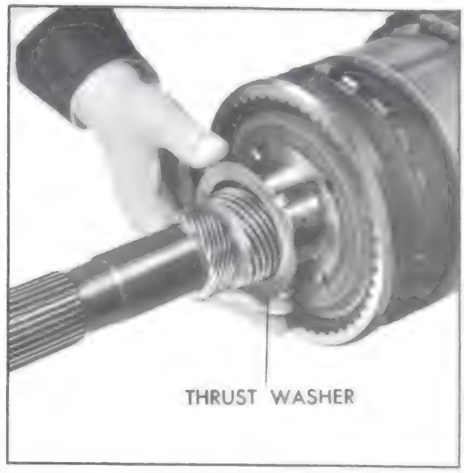


Figure 5-677

11. Install the reaction carrier to output carrier thrust washer with the tabs facing down in pockets. See Figure 5-678.

Figure 5-678

12. Install the sun gear splines with chamfer down. See Figure 5-680.

13. Install the sun gear shaft.

14. Install the reaction carrier. See Figure 5-681.

15. Install the center support to sun gear thrust races and bearing as follows:

Figure 5-680

Figure 5-681

a. Install the large race, center flange up over the sun gear shaft.

b. Install the thrust bearing against the race.

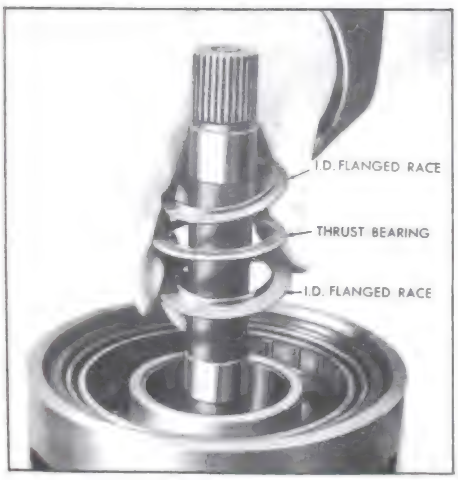


Figure 5-682 -

c. Install the second race, center flange up. See Figure 5-682.

16. Install the bronze center support to reaction carrier thrust washer into the recess in the center support. Retain with petrolatum. See Figure 5-683.

Figure 5-683

17. Using Tool J-21367, as apilot, install the rear sprag assembly on case center support inner race with bronze drop strips up. See Figure 5-684.

18. Install the case center support and sprag assembly as follows:

a. Place a rubber band on the sprag assembly O.D. to hold the sprags in place. See Figure 5-685.

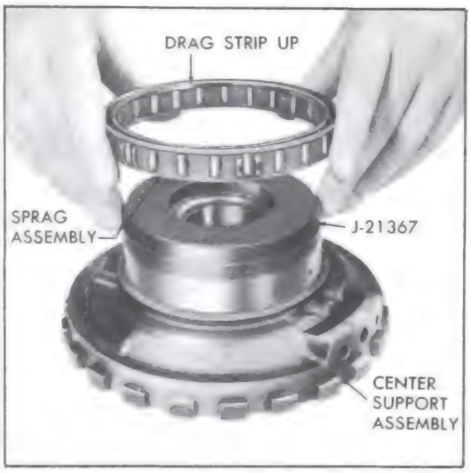


Figure 5-684

Figure 5-685

b. Start sprag assembly into outer race, remove the rubber band and finish installation by pressing on case support. See Figure 5-686.

NOTE: <u>With reaction carrier held, case support should only turn counterclockwise.</u>

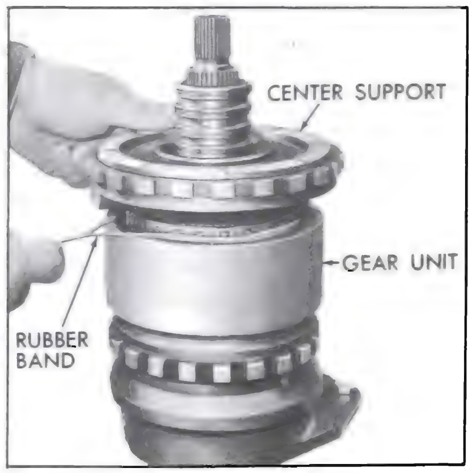


Figure 5-686

5-27 ASSEMBLY OF UNITS INTO TRANSMISSION CASE

1. Install the "O" ring seal on the park pawl shaft.

2. Install the parking pawl, tooth toward the inside case and parking pawl shaft. See Figure 5-687.

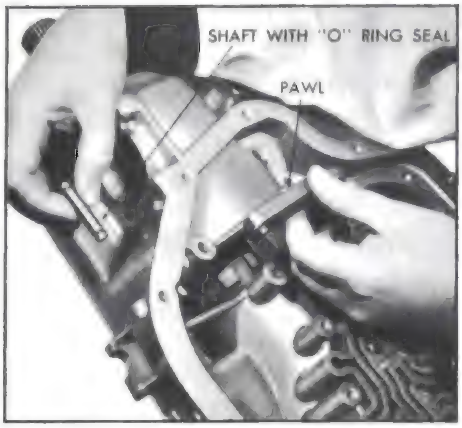


Figure 5-687

3. Install the parking pawl shaft retainer clip. See Figure 5-688.

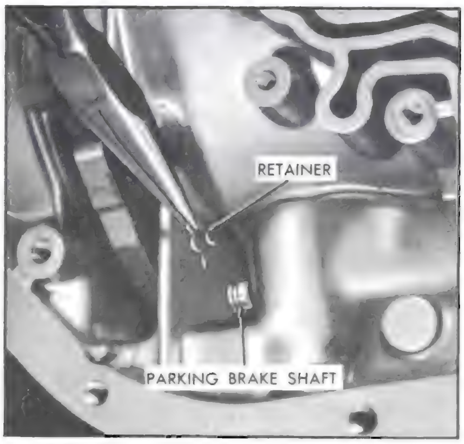


Figure 5-688

4. Install the parking pawl return spring, square end hooked on pawl. See Figure 5-690.

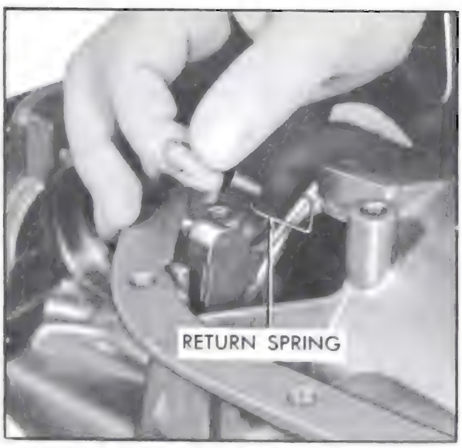


Figure 5-690

5. Install the parking brake bracket, guides over parking pawl, using two attaching bolts torque to 15-20 ft. lbs. See Figure 5-691.

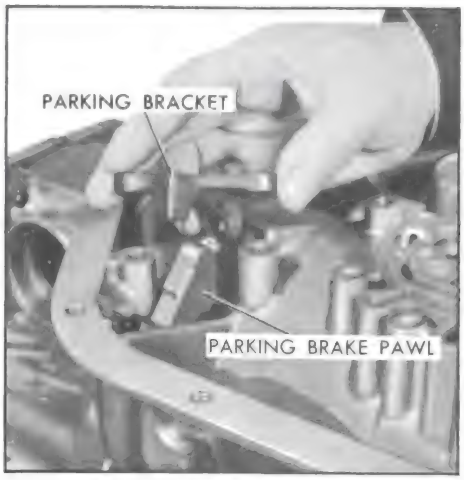


Figure 5-691

6. Install the rear band assembly so that the two lugs index with the two anchor pins. See Figure 5-692.

Figure 5-692

7. Install the rear selective washer into slots provided inside rear of transmission case. See Figure 5-693.

8. Install the complete gear unit assembly into the case. See Figure 5-694.

Figure 5-693

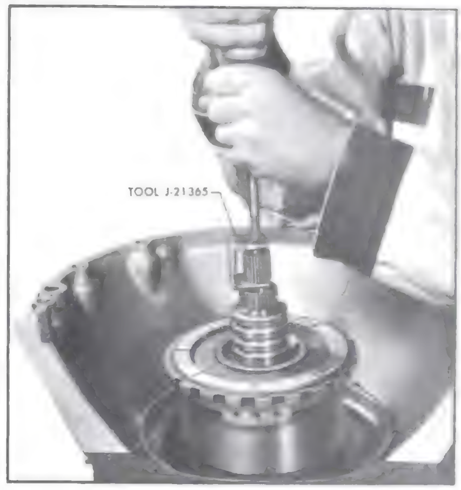


Figure 5-694

9. Oil and install center support to case retaining snap ring with bevel facing top of transmission. Make certain ring is properly seated in case.

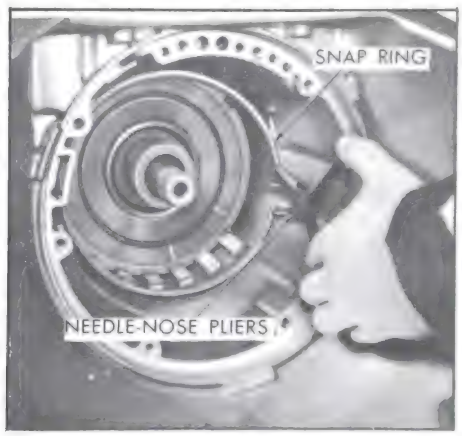


Figure 5-695

NOTE: Ring is tapered, flat side towards center support. See Figure 5-695.

10. Install center support locating screw, then install the case to center support screw. See Figure 5-696.

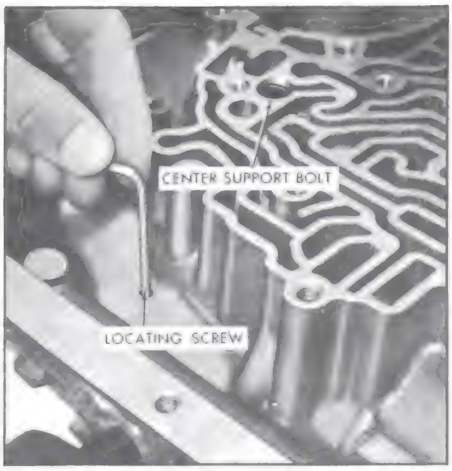


Figure 5-696

11. Install three (3) steel and three (3) composition intermediate clutch plates.

Start with steel, alternate the plates. See Figure 5-697.

12. Install the intermediate clutch backing plate.

13. Install the backing plate to case snap ring. Gap in snap ring should be opposite anchor pin. See Figure 5-698.

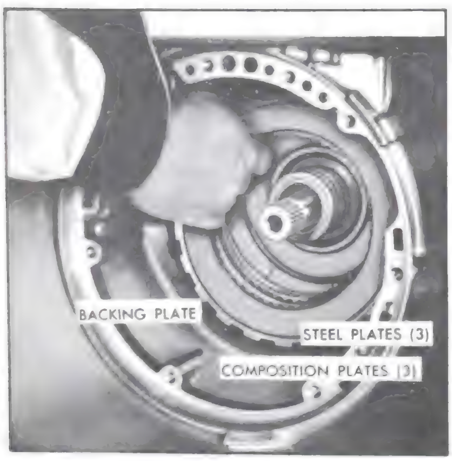


Figure 5-697

Figure 5-698

14. Check rear end play as follows: See Figure 5-700.

Figure 5-700

Figure 5-700A

a. Install J-7004 into an extension housing attaching bolt hole. See Figure 5-700A.

b. Mount the dial indicator, J-8001, on the rod and index with the end of the output shaft.

c. Apply air pressure to apply the intermediate clutch (center oil passage) while moving the output shaft in and out to read the end play. End play should be from .003" - .019". The selective washer controlling this end play is the steel washer having 3 lugs that is located between the thrust washer and the rear face of the transmission case.

If a different washer thickness is required to bring the end play within specification, it can be selected from the following chart.

Thickness	Notches
.078 - .082	None
.086 - .090	1 Tab Side
.094 - .098	2 Tabs Side
.102 - .106	1 Tab O.D.
.110 - .114	2 Tabs O.D.
.118 - .122	3 Tabs O.D.

15. Install front band with band anchor hole placed over the band anchor pin and apply lug facing servo hole. See Figure 5-701.

Figure 5-701

16. Install the direct clutch and intermediate sprag assembly. It will be necessary to twist the housing to allow the sprag outer race to index with the clutch drive plates. The housing hub will bottom on the sun gear shaft. See Figure 5-702.

NOTE: Removal of direct clutch, drive and driven plates, may be helpful.

Figure 5-702

17. Install the forward clutch hub to direct clutch housing bronze thrust washer on the forward clutch hub. Retain with petrolatum.

18. Install the forward clutch assembly, indexing the direct clutch hub so end of the mainshaft will

Figure 5-704

be flush with the end of the forward clutch hub, using the turbine shaft as tool. See Figure 5-703.

19. Install the turbine shaft, end with short spline into forward clutch housing. See Figure 5-704.

20. Position the pump to case gasket against the case face.

21. Install the front pump assembly and all but one attaching bolt and seal.

NOTE: If the turbine shaft can not be rotated as the pump is being pulled into place, the forward or direct clutch housings have not been properly installed to index with all the clutch plates. This condition must be corrected before the pump is pulled fully into place.

22. If necessary, install a new front seal, using tool J-21359, to drive the seal in place. See Figure 5-705.

23. Check front unit end play as follows. See Figure 5-706.

a. Remove one front pump attaching bolt, and bolt seal.

b. Install J-7004 slide hammer into bolt hole. (See illustration for location.)

c. Mount the dial indicator on the rod and index indicator to register with end of turbine shaft.

d. Hold output shaft forward while pushing turbine shaft rearward to its stop.

e. Set dial indicator to zero.

f. Push forward clutch housing forward using a rod inserted through the exhaust port in transmission case.

Read the resulting travel or end play which should be .003"-.024".

The selective washer controlling this end play is the phenolic resin washer located between the pump cover and the forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select the proper washer from the chart below.

Figure 5-703

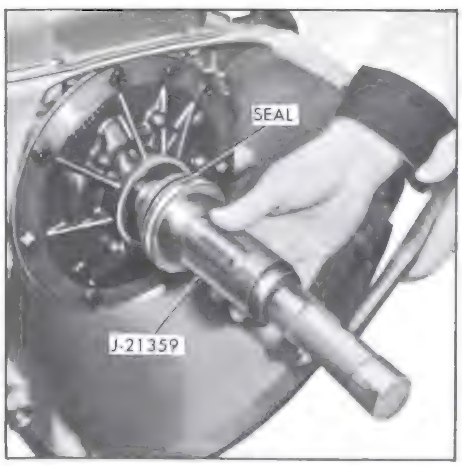


Figure 5-705

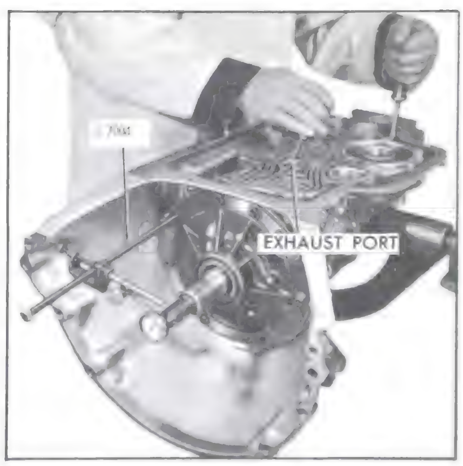


Figure 5-706

Thickness	Color
.060 - .064	Yellow
.071 - .075	Blue
.082 - .086	Red
.093 - .097	Brown
.104 - .108	Green
.115 - .119	Black

NOTE: An oil soaked washer may tend to discolor so that it will be necessary to measure the washer for its actual thickness.

24. Install the remaining front pump attaching bolt and seal. Torque bolts to 15-20 ft. lbs.

5-28 REAR EXTENSION HOUSING ASSEMBLIES

1. Install the extension housing to case "O" ring seal on the extension housing.

2. Attach the extension housing to the case using attaching bolts. Torque bolts to 20-25 ft. lbs.

3. If necessary, install a new rear seal, using Seal Installer Tool J-21464. See Figure 5-707.

Figure 5-707

5-29 INSTALL MANUAL LINKAGE

1. If necessary, install a new manual shaft seal into the case.

2. Insert the actuator rod into the manual detent lever from the side opposite the pin.

3. Install the actuator rod retaining "E" ring.

4. Install the actuator rod plunger under the parking bracket and over the parking pawl.

5. Install the manual lever and shaft assembly through the case and detent lever. See Figure 5-708.

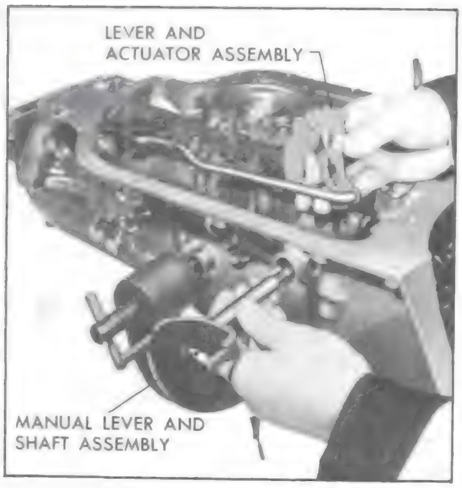


Figure 5-708

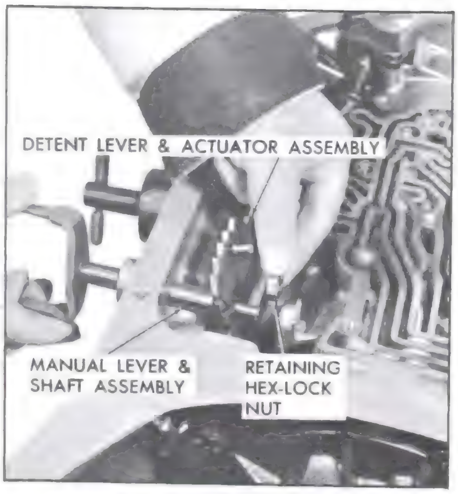


Figure 5-710

6. Install the retaining hex-lock nut on the manual shaft. See Figure 5-710.

NOTE: Start hex-nut on manual shaft, engaging manual valve with detent pin.

Tighten detent retaining nut.

5-30 INSTALLATION OF CHECK BALLS, FRONT SERVO, GASKETS, SPACER AND SOLENOID

1. Install the front servo assembly into the transmission case. Be sure the oil seal ring is started in the case bore. See Figure 5-711.

Figure 5-711

2. Install the valve body spacer to case gasket. (Gasket with tab.) See Figure 5-712.

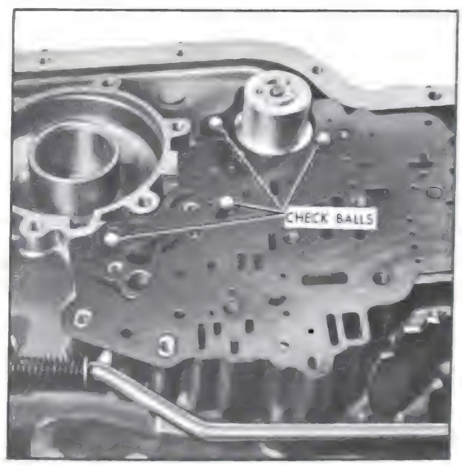


Figure 5-712

3. Install four (4) check balls into the transmission case pockets.

4. Install the valve body to case spacer.

5. Install the solenoid gasket. See Figure 5-713.

Figure 5-713

6. Install the solenoid assembly with connector facing outer edge of case, using attaching bolts.

NOTE: Do not tighten bolts at this time.

7. Install the "O" seal ring on the solenoid connector.

8. Install the connector with the lock tabs facing into the case. See Figure 5-714.

9. Connect the solenoid lead to the connector terminal. See Figure 5-715.

Figure 5-714

Figure 5-715

5-31 INSTALLATION OF REAR SERVO ASSEMBLY

NOTE: Before installing the rear servo assembly check band apply pin using tool J-21320 as follows:

a. Attach the band apply pin Selection Gauge J-21370, to the transmission case with attaching screws.

b. Apply 15 ft. lb. torque and select proper servo pin to be used from scale on tool. See Figure 5-715A.

c. Remove the tool and make note of the proper pin to be used during assembly of the transmission.

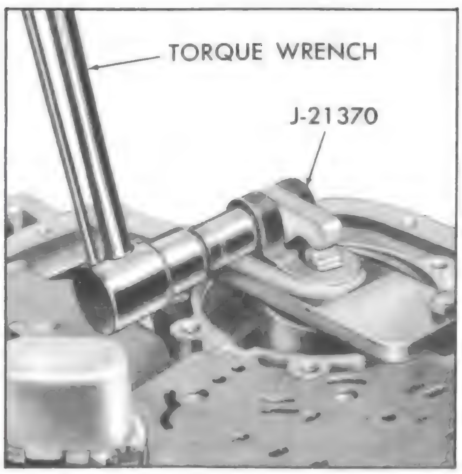


Figure 5-715A

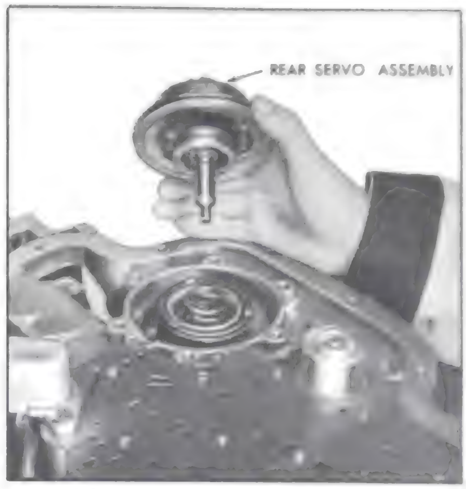


Figure 5-716

There are three selective pins identified as follows:

Pin Identification	Pin Size
Two	Long
One Ring	Med.
No Rings	Short

The identification ring is located on the band lug end of the pin. Selecting the proper pin is the equivalent of adjusting the band.

1. Install rear accumulator spring.

2. Install the rear servo spring assembly; the side of the retainer having the long ears, faces up or out of the case. See Figure 5-716.

Figure 5-717

3. Install the servo assembly, being sure to align the relieved pockets in the piston over the tabs on the spring retainer. See Figure 5-716.

4. Install the rear servo gasket and cover. See Figure 5-717.

5. Install attaching screws. Torque bolts to 15-20 ft. lbs. See Figure 5-718.

Figure 5-718

6. Air check piston to make certain seal has not been damaged. See Figure 5-720.

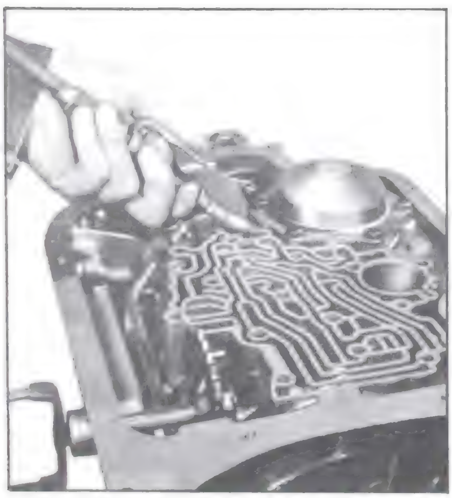


Figure 5-720

5-32 INSTALLATION OF CONTROL VALVE ASSEMBLY AND GOVERNOR PIPES

1. Install control valve to spacer gasket. See Figure 5-721.

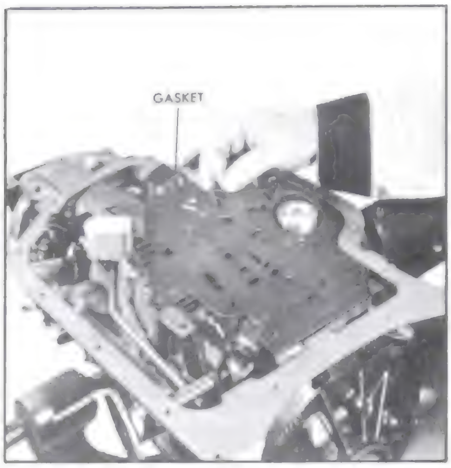


Figure 5-721

2. Install governor pipes into assembly. See Figure 5-722.

Figure 5-722

3. Install two guide pins (control valve assembly attaching screws with heads removed). See Figure 5-723.

4. Install control valve assembly and governor pipes to the transmission.

NOTE: Be sure the manual valve is properly indexed with the pin on the manual detent lever.

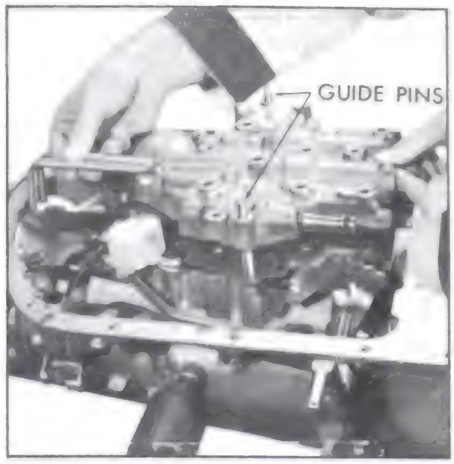


Figure 5-723

5. Remove guide pins.

6. Install the control valve assembly attaching bolts and manual detent and roller assembly. Center roller on detent. See Figure 5-724.

NOTE: One bolt has copper washer. See Figure 5-508.

7. Tighten the solenoid and control valve attaching bolts. Torque bolts to 6-10 ft. lbs.

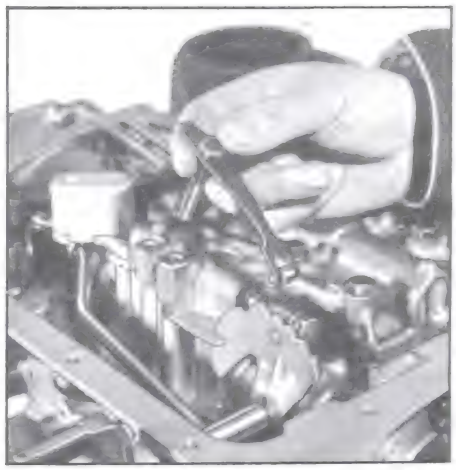


Figure 5-724

5-33 INSTALLATION OF STRAINER AND INTAKE PIPE

1. Install the case to intake pipe "O" seal ring on strainer and intake pipe assembly. See Figure 5-725.

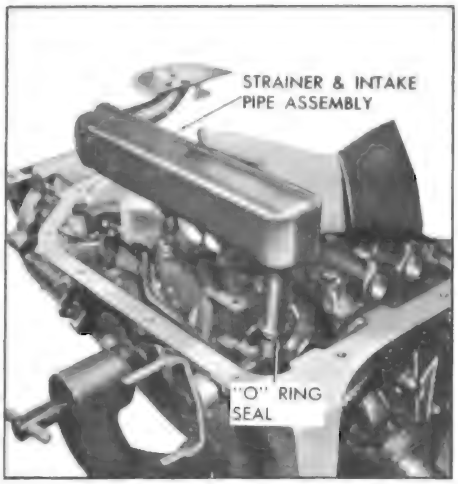


Figure 5-725

2. Install the strainer and intake pipe assembly.

3. Install a new bottom pan gasket and the bottom pan.

4. Install the modulator shield and all the bottom pan attaching screws. Torque bolts to 10-13 ft. lbs.

5-34 INSTALLATION OF MODULATOR VALVE AND VACUUM MODULATOR

1. Install the modulator valve into the case, stem end out. See Figure 5-726.

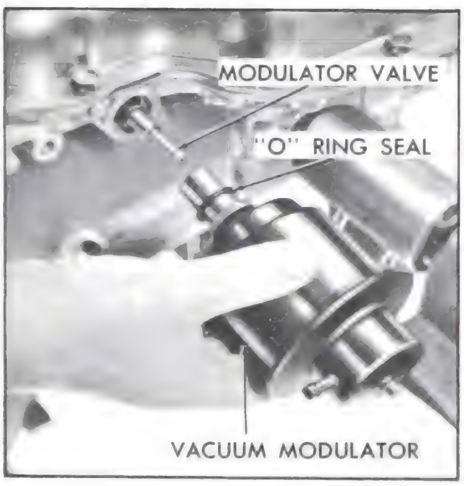


Figure 5-726

2. Install the "O" ring seal on the vacuum modulator.

3. Install the vacuum modulator into the case.

4. Install the modulator retainer and attaching bolt. Torque bolt to 15-20 ft. lbs. See Figure 5-727.

Figure 5-727

5-35 INSTALLATION OF GOVERNOR ASSEMBLY

1. Install the governor assembly into the case. See Figure 5-728.

2. Attach the governor cover and gasket with four (4) attaching bolts. Torque bolts to 15-20 ft. lbs. See Figure 5-730.

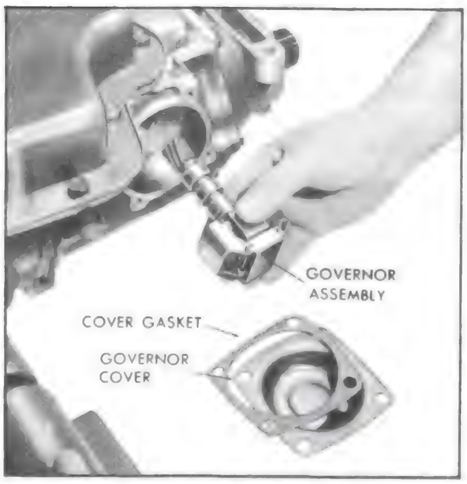


Figure 5-728

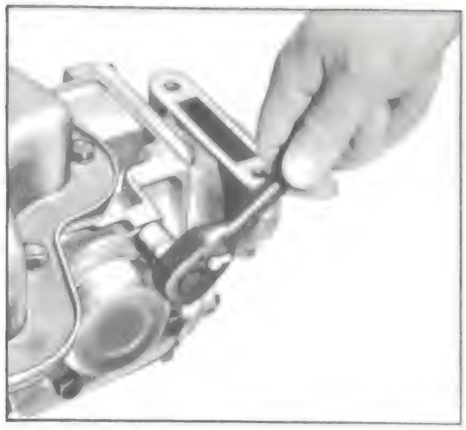


Figure 5-730

5-36 INSTALLATION OF SPEEDOMETER DRIVEN GEAR ASSEMBLY

1. Install the speedometer driven gear assembly. See Figure 5-731.

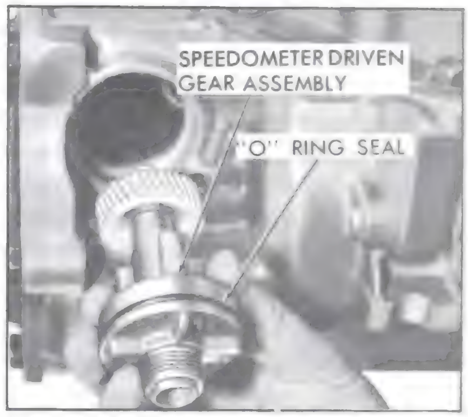


Figure 5-731

2. Install the speedometer driven gear retainer and attaching bolt. See Figure 5-732.

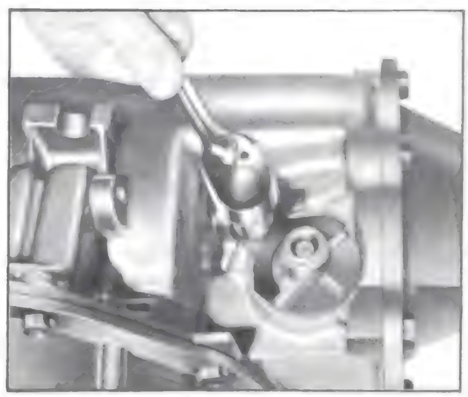


Figure 5-732

SECTION 5-E
TROUBLE DIAGNOSIS

CONTENTS OF SECTION 5-E

5-34 DIAGNOSIS PROCEDURE

Accurate diagnosis of apparent transmission problems begins with a thorough understanding of normal transmission operation. In particular, knowing which units are involved in the various speeds or shifts so that the specific units or circuits involved in the problem can be isolated and investigated further.

An important and often overlooked aspect of diagnosis is finding out specifically what the customer is complaining of. For this purpose, a short ride with the customer will often prove beneficial. In some cases through a customer's misunderstanding of how the transmission should operate, it may be found that the condition the customer wants corrected is standard and should not be altered. Determine that all shifts are being obtained in the following manner:

3RD AND 2ND CHECK

Position the selector lever in the Drive position, and keep the car speed at approximately 35 MPH. While gradually accelerating, move the selector lever to Lo Range. The transmission should downshift to 2nd. An increase in engine RPM and an engine braking should be noticed.

2-1 CHECK

Leaving the selector lever in Lo Range and coasting down to approximately 18 MPH, the transmission should downshift to 1st gear. An increase in engine RPM and braking effect should be noticed.

The following sequence provides the desired information quickly and in most cases corrects the malfunction without requiring the removal of the transmission.

5-35 DIAGNOSIS SEQUENCE

A. OIL LEVEL

B. OIL PRESSURE

C. MANUAL LINKAGE

D. ENGINE IDLE AND DASH POT ADJUSTMENT

E. VACUUM LINE

F. VACUUM MODULATOR ASSEMBLY

G. DETENT SWITCH AND SOLENOID

H. GOVERNOR ASSEMBLY

I. CONTROL VALVE ASSEMBLY

J. REAR SERVO ASSEMBLY

K. FRONT SERVO ASSEMBLY

L. FORWARD CLUTCH

M. INTERMEDIATE CLUTCH

N. DIRECT CLUTCH

O. FRONT AND REAR BANDS

a. Oil Level

Before attempting to check and or correct any transmission complaint it is absolutely essential that the oil level be checked and corrected if necessary. Either too high or too low an oil level can cause slippage in all ranges or excessive noise.

Oil level should be checked with the selector lever in the Park (P) position, engine running, and the vehicle on level pavement. The transmission oil should be at operating temperature 170°. (This can be accomplished by driving approximately 5 miles with frequent starts and stops). If oil level is low, add automatic transmission fluid to "Full" mark.

If oil level was low, refer to Oil Leaks Page 11.

b. Oil Pressure

Check and correct oil level (Item A).

Before road testing an oil pressure gauge should be connected and the pressures checked as follows:

Engine Idle
Pressure Check

With the selector lever in "DR" Range and vehicle running at 30 MPH, with the throttle closed, line pressure should be 70 psi.

Full Throttle
Pressure Check

A satisfactory full throttle pressure check can be made with the vacuum line removed from carburetor, transmission in Neutral and engine speed at fast idle (700-1000). This pressure should be 145 psi.

In order to completely diagnose a specific shift trouble it may be necessary to check the line pressure at the full throttle 1-2 and 2-3 shift points. If this becomes necessary a road test must be made in an uncongested area. The pressure at the 1-2 full throttle shift point is 120 psi and at the 2-3 full throttle shift point it is 100 psi. This check will point out any errors in the governor feed oil to the modulator.

If the pressure was low check:

1. The vacuum modulator assembly for loose attaching bolt, collapsed bellows, stuck modulator valve.

2. The pressure regulator valve and spring for sticking plugged orifice, collapsed spring.

3. Boost valve for - sticking.

If the engine idle pressure was high; check:

1. Vacuum line (See Item E).

2. Vacuum modulator for leaks (See Item F).

3. Modulator valve for sticking.

4. Pressure regulator valve for sticking.

5. Boost valve for sticking.

c. Manual Linkage

Manual linkage adjustment and the associated neutral safety switch are important from a safety standpoint. The safety switch should be adjusted so that the engine will start only in Park or Neutral.

With the selector lever in Park position, the parking pawl should prevent the vehicle from rolling. The pointer on the indicator quadrant should line up properly with the range indicators in all ranges.

d. Engine Idle Speed and Dash Pot Adjustment

Specific instructions for adjustment vary from one model to another, so it will be necessary to refer to the car manufacturer's Service Manuals for details.

e. Vacuum Line Check

1. Check vacuum line for:

A. Leaks

B. Plugged

C. Crimped

D. Plugged Carburetor orifice.

f. Vacuum Modulator Assembly

The vacuum modulator assembly controls the transmission line pressure. A faulty vacuum modulator assembly, such as a leaking diaphragm, bellows or a stuck modulator valve may cause:

1. High line pressure.

2. Low line pressure.

3. High shift points.

4. Low shift points.

5. Harsh shifts.

6. Slipping shifts.

g. Detent Switch and Solenoid

The detent switch and solenoid can be checked by listening for the detent solenoid to click while operating the switch by hand (with the ignition "ON" but engine not running). If the solenoid did not engage:

1. Check detent switch and adjust (See Shop Manual for adjustment).

2. Check electrical connections.

3. Replace the detent solenoid.

If the solenoid did engage, but the shift points were late (detent shifts) check:

1. For loose solenoid attaching screws.

2. Mispositioned solenoid gasket.

3. Solenoid for plugged orifice.

4. For a leak between control valve assembly spacer plate and case.

a. Bent spacer.

b. Blown gasket.

c. Case face not flat.

h. Governor Assembly

The governor assembly controls the transmission shift points. A stuck governor can cause:

1. No upshift.

2. 2nd or 3rd Gear start.

3. Low or high line pressures.

i. Control Valve Assembly Check

The control valve assembly check involves a disassembly and a thorough inspection of the control valve assembly with particular attention to the following items.

1. Bolts

Attaching bolts must not be loose or excessive leakage will occur

between the adjacent channels. Over torquing the bolts can cause distortion or warpage, which also causes leakage and sticking valves.

2. Distorted or Mispositioned Springs In Valve Body

The position and condition of the springs is important. The exact number of springs and their location varies with model of transmission. Reference to the manufacturer's shop manual will be helpful in determining the exact location and number of springs.

3. Sticky Valves

The valves should be free enough to fall because of their own weight. Burrs or small dents can be removed using a fine abrasive stone. The sharp edges on the valve lands should not be removed.

4. Porosity

Porosity between channels or passages can be detected by using a solvent and observing if any leakage occurs.

5. Bodies or Plates Out of Flat

The valve body, case and spacer plate, must be flat or cross leakage can occur.

A surface plate and bluing is useful in checking for out of flat conditions of the bodies. Gentle and careful lapping of the valve body sealing faces will often correct an out of flat condition.

j. Rear Servo

The rear servo applies the rear band in reverse, and Lo Range 1st gear. It also is the accumulator for the 1-2 shift. A faulty rear servo, such as a leaking accumulator or servo piston oil seal, a stuck piston, or wrong piston, pin can cause:

1. Slipping 1-2 Shift
2. Harsh 1-2 Shift
3. Slipping Reverse
4. No Reverse
5. No Overrun Braking in Lo Range.

k. Front Servo

The front servo applies the front band in 2nd gear for overrun braking. It also acts as an accumulator for the 2-3 shift. A faulty servo, such as a broken oil seal ring, or stuck piston, may cause:

1. Slipping 1-2 Shift
2. Slipping 2-3 Shift
3. No 3rd Gear
4. No Engine Braking in 2nd
5. Harsh 2-3 Shift

l. Forward Clutch

The forward clutch is the connection between the converter and the transmission gear set and is applied in all forward driving ranges.

No forward drive or slipping first gear may be caused from the following:

1. Missing or broken pump oil seal ring.
2. Leaking inner or outer piston seal.
3. Check ball stuck.
4. Clutch plates worn.

m. Intermediate Clutch

The intermediate clutch is applied in second gear, which makes the sprag effective in holding the sun gear shaft and sun gear from turning counterclockwise.

A slipping 1-2 shift or no 2nd gear may be caused from:

1. Leaking piston seals.
2. Worn clutch plates.
3. Loose case to case center support bolt.

n. Direct Clutch

1. Leaking piston seals.
2. Stuck check ball.
3. Broken or missing case support oil seal rings.
4. Worn clutch plates.
5. Loose case to center support bolt.

The direct clutch is applied in 3rd gear and reverse to drive the sun gear clockwise.

A slipping 2-3 shift, slipping reverse, no 3rd gear, or no reverse, may be caused from:

o. Front and Rear Bands

The front and rear bands are used to back up the sprags for overrun braking.

A broken or burnt front band will cause no 2nd gear over-run braking.

A broken or burnt rear band will cause no first gear over-run braking in Lo Range, and no reverse.

5-36 DIAGNOSIS GUIDE

CONDITION	POSSIBLE CAUSE
No Drive in Drive Range	A-B-C-I-L
First Speed Only - (No. 1-2 Shift)	F-G-H-I-J-M
No Third Gear (No. 2-3 Shift)	H-I-K-N
Drive in Neutral	C-L
No Reverse	A-B-C-I-J-N-O
Slipping - All Ranges	A-B-F-H-I
Slipping - 1-2 Shift	A-B-F-I-J-K-M
Rough 1-2 Shift	B-D-E-F-G-I-J-M
Slipping 2-3 Shift	A-B-F-I-K-N
Rough 2-3 Shift	B-D-E-F-G-I-N
No Engine Braking (Lo Range Second Gear)	I-K-O
No Engine Braking (Lo Range First Gear)	I-J-O
No Part Throttle Downshifts	A-B-F-H-I
No Detent Downshifts	E-F-G-I
Low or High Shift Points	A-B-E-F-G-H-I

5-37 OIL LEAKS

If a transmission is found consistently low on oil an inspection should be made to find and correct all external oil leaks.

All external oil leaks should be traced to their original source. Due to wind currents, a leak at the manual lever seal can form a pool of oil at the rear bottom pan bolts, indicating a leak at the bottom pan bolts. The use of black light can be helpful in determining source of leak.

The vacuum modulator must also be checked to insure that the diaphragm has not ruptured, as this would allow transmission oil to be drawn into the intake manifold. Usually, the exhaust will be excessively smokey, due to transmission oil added to the combustion.

5-38 POSSIBLE POINTS OF EXTERNAL OIL LEAKS

1. Bottom Pan Gasket
2. Bottom Pan Bolt
3. Porosity In Case
4. Case Extension To Case
5. Rear Seal
6. Front Seal
7. Governor Cover Plate
8. Speedo Gear Housing "O" Ring
9. Speedo Shaft to Housing Seal
10. Detent Solenoid Adapter "O" Ring
11. Manual Lever Seal
12. Pump To Case "O" Ring
13. Vacuum Modulator Assembly To Case "O" Ring
14. Filler Pipe
15. Parking Pawl Shaft "O" Ring
16. Front Pump To Case Bolt "O" Ring
17. Converter Weld
18. Vent Pipe
19. Cooler Fittings
20. Pressure Take-Off Plug
21. Vacuum Modulator Diaphragm

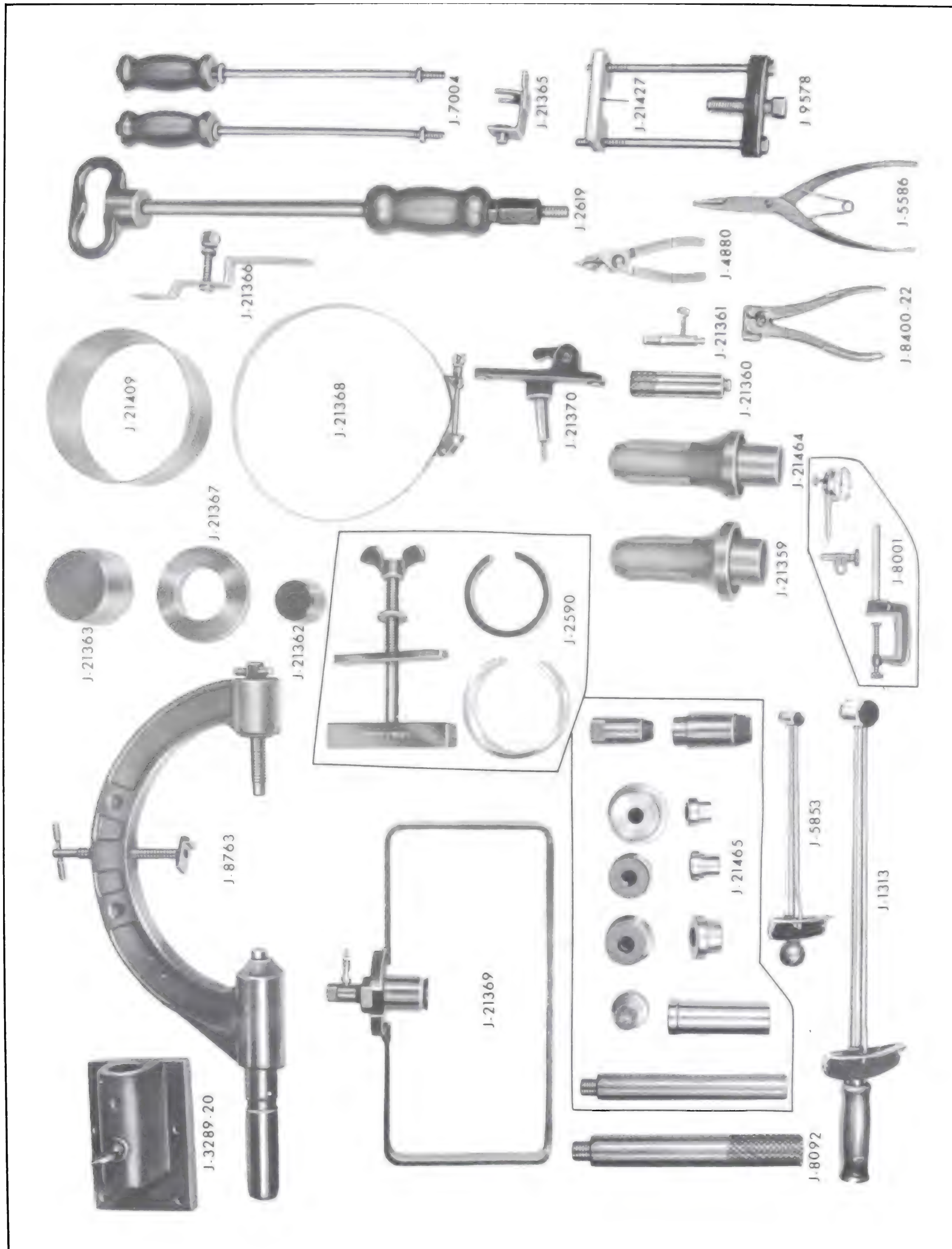


Figure 5-733—Special Tools

J-3289-20	-	HOLDING FIXTURE BASE
J-8763	-	HOLDING FIXTURE
J-21363	-	SEAL INSTALLER
J-21367	-	LOW SPRAG INSTALLER
J-21362	-	SEAL INSTALLER
J-21409	-	SEAL INSTALLER
J-21368	-	PUMP BODY TO COVER ALIGNMENT BAND
J-21366	-	CONVERTER HOLDING STRAP
J-2619	-	SLIDE HAMMER
J-7004	-	SLIDE HAMMERS
J-21360	-	CHECK VALVE INSTALLER
J-21361	-	CHECK VALVE REMOVER
J-4880	-	SNAP RING PLIERS
J-5586	-	SNAP RING PLIERS
J-9578	-	SPEEDO GEAR REMOVER
J-21365	-	GEAR ASSEMBLY REMOVER AND INSTALLER
J-21370	-	APPLY PIN SELECTION GAUGE
J-8001	-	DIAL INDICATOR SET
J-21464	-	REAR SEAL INSTALLER
J-21359	-	OIL PUMP SEAL INSTALLER
J-21369	-	CONVERTER PRESSURE CHECK FIXTURE
J-21465	-	BUSHING SET
J-8092	-	DRIVE HANDLE
J-5853	-	IN. LB. TORQUE WRENCH
J-1313	-	FT. LB. TORQUE WRENCH

Figure 5-734—Special Tools

GROUP 6

REAR AXLE ASSEMBLY

SECTIONS IN GROUP 6

SECTION 6-A

REAR AXLE SPECIFICATIONS, DESCRIPTION, TROUBLE DIAGNOSIS

CONTENTS OF SECTION 6-A

6-1 REAR AXLE SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed, to insure proper tightening without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque Ft. Lbs.
Bolt	Center Bearing Support to Frame	5/16-24	35-45
Nut	Clamp, Rear Universal Joint to Pinion Flange	5/16-18	12-15
Nut	Differential Carrier to Housing	3/8-16	45-55
Nut	Spring, Upper End to Frame	1/2-13	15-20
Bolt	Track Bar Cross Member Brackets to Frame	3/8-16	40-55
Bolt & Nut	Upper Control Arm, Inner to Outer Arm	7/16-14	60 Min.
Bolt & Nut	Rear Shock, Lower End to Axle Bracket	7/16-14	35 Min.
Bolt	Ring Gear to Case	7/16-20	65-75
Nut	Wheel Bearing Retainer and Brake Assembly to Housing	3/8-16	40-55
Bolt & Nut	Differential Bearing Support Clamping	1/2-20	40-50
Nut	Spring, Lower End to Lower Control Arm	1/2-13	20-30
Nut	Rear Shock, Upper End to Frame	1/2-13	35-45
Nut	Wheel and Brake Drum to Rear Axle Shaft	1/2-20	65-85
Bolt & Nut	Track Bar to Axle or Frame Bracket	5/8-18	100-140
Bolt & Nut	Control Arm Pivot, All	1/2-13	80-110
Nut	Pinion Bearing Lock	7/8-14	200-300

b. General Specifications

Items	All Series
Rear Axle Type	Semi-Floating Hypoid
Drive and Torque	Through 3 Control Arms
Rear Axle Oil Capacity	4 1/2 Pints

b. General Specifications (Cont.)

Items	All Series
Ring and Pinion Gear Set Type	Hypoid
Bolted Ring Gear	12 Bolts—7/16 Alloy
Pinion Position Adjustment	Shims
Pinion Bearing Preload Adjustment	Spacers
Ring Gear Position and Preload Adjustment	Shims
Rear Universal Joint Angle Adjustment	Vernier—Upper Control Arm
Differential Cover	Welded to Housing
Propeller Shaft	2 Piece—Open Drive Line
Center Support	Ball Bearing
Universal Joints	2 Single—1 Double Constant Velocity

c. Limits for Fitting and Adjusting

Pinion Position	± .0015 from Marking on Pinion
Pinion Bearing Preload	15-35 Inch Lbs. Torque on Pinion with New Seal
Ring Gear Position	.007-.009 Backlash
Ring Gear Preload	.004 Compression (.002 per side)

d. Rear Axle Gear Ratios

Gear ratios are indicated by numbers stamped on the bottom of the axle housing. The production date is also indicated by a stamped number which represents the day of the year starting with "1" for January 1. See Figure 6-1.

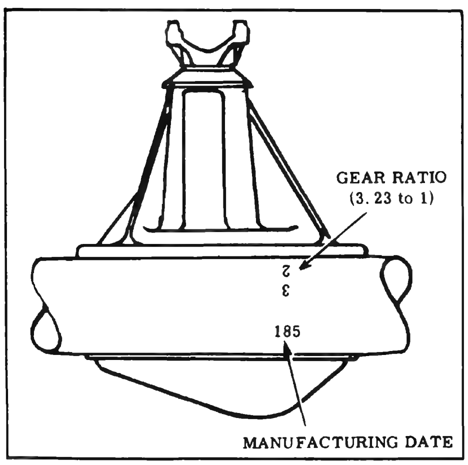


Figure 6-1—Rear Axle Ratio Identification

e. Speedometer Gears

Speedometer gears must correspond to axle ratios and tire sizes in order to have correct speedometer and odometer readings.

6-2 DESCRIPTION OF REAR AXLE

The rear axle assembly is of the semi-floating type in which the car weight is carried on the axle shafts through ball bearings enclosed in the outer axle housing. The rear axle is designed for use with an open drive line and coil springs. Drive from the axle housing is transmitted to the frame through one upper and two lower control arms. The lower control arms also provide seats for the coil springs; the upper control arm is adjustable in length to give the desired universal joint angle. Large rubber bushings at both ends of these control arms absorb vibration and noise. The final drive is a hypoid type ring gear and pinion with the centerline of the pinion gear below the centerline of the ring gear. See Figure 6-2.

The drive pinion is mounted in two tapered roller bearings which are preloaded by two selected spacers at assembly. See Figure 6-3. The pinion is positioned by a shim located between the head of the drive pinion and the rear pinion bearing. The front bearing is held in place by a large washer and a locking pinion nut. The differential carrier casting has an oil feed passage to the pinion bearings and an oil return hole so that the oil will circulate and cool.

The differential is supported in carrier by two tapered roller side bearings. These are preloaded by inserting shims between the bearings and the pedestals. The differential assembly is positioned for proper gear and pinion back-lash by varying these shims. The bearings are centered on the cross axis by lock taper cones secured in the pedestal bores by clamp bolts. The ring gear is bolted to the case. The case houses two side gears in mesh with two pinions mounted on a pinion axle which is anchored in the case by a spring pin. The pinions and side gears are backed by bronze thrust washers.

The axle shaft inner splines engage the differential side gears with a floating fit. The outer ends are supported in the axle housing by thrust type ball bearings which are factory packed for the life of

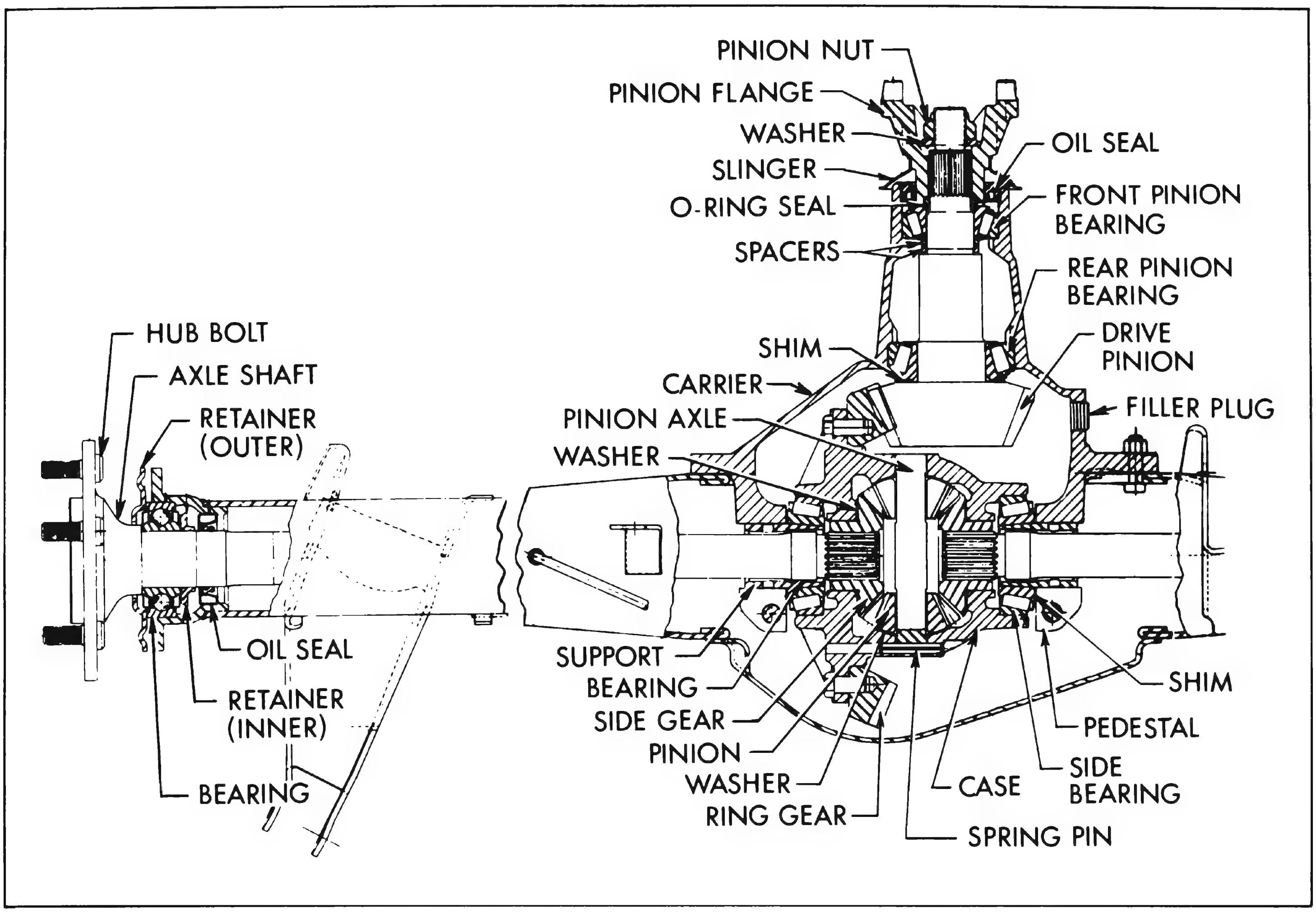


Figure 6-2—Rear Axle Assembly

the bearings and sealed on both sides. The axle shaft oil seals are located inboard of the bearings. The bearings are secured against a shoulder on the shaft by a press fit retaining ring. Inward movement of the bearing and shaft assembly is stopped by a shoulder in the housing; outward movement is stopped by a retainer plate. Wheel side through is taken at the wheel bearings, so an axle shaft

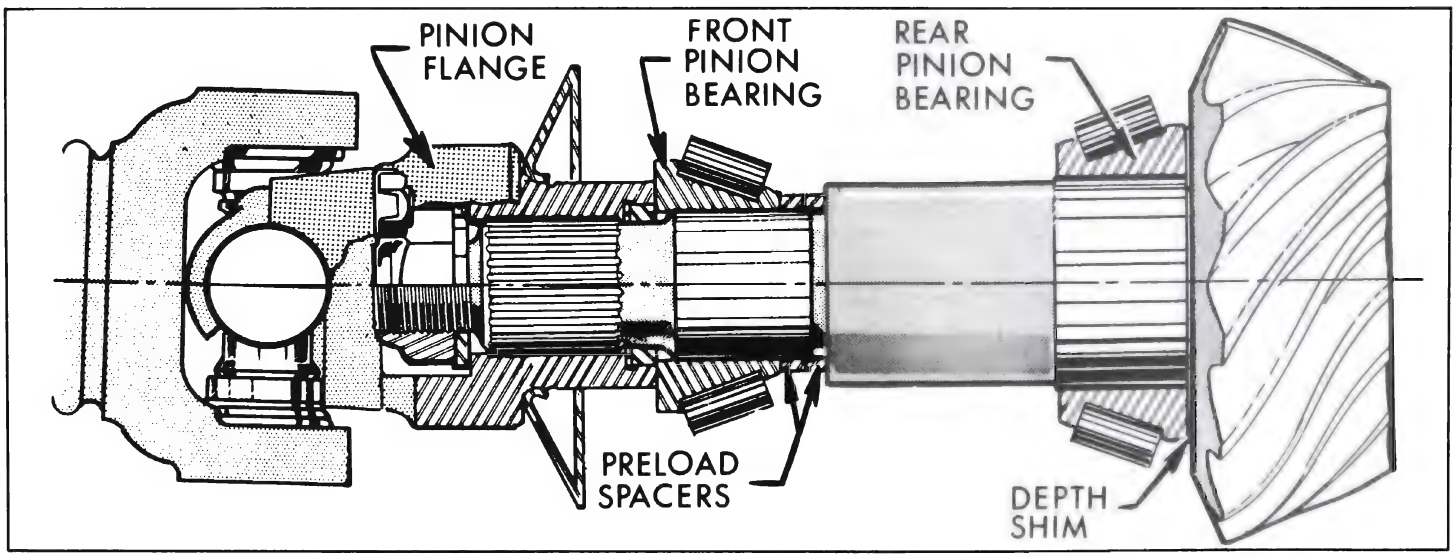


Figure 6-3—Drive Pinion Parts

may be removed by removing the nuts holding the bearing retainer and brake backing plate to the axle housing flange. See Figure 6-4.

The rear axle filler plug is located in the right side of the carrier casting. The lubricant level is correct when the level is at the filler opening to 1/4 inch below the filler opening. Since periodic lubricant changes are not recommended, there is no drain plug. The rear brake drum is mounted against the axle shaft flange on bolts pressed through the inboard side of the axle flange. Right and left side wheel bolts both have right hand threads.

A seal in the front of the carrier bears against the pinion flange to prevent differential gear oil from leaking around the O.D. of the flange. An "O" ring seal is compressed between the pinion flange and the drive pinion to prevent gear oil from leaking out through the splines. See Figure 6-2.

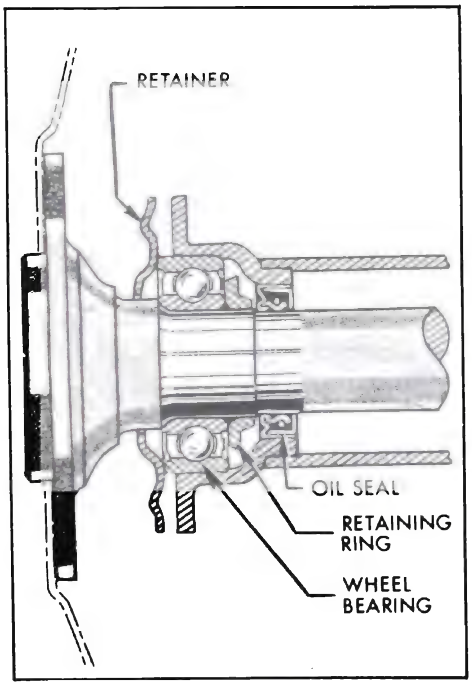


Figure 6-4—Rear Wheel Bearing and Seal

6-3 REAR AXLE TROUBLE DIAGNOSIS

a. Elimination of External Noises

When a rear axle is suspected of being noisy it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, front wheel bearings, engine, transmission, or rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

(1) Road Noise. Some road surfaces, such as brick or rough surfaced concrete, cause noise which may be mistaken for tire or rear axle noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of noise. Road noise usually is the same on drive or coast.

(2) Tire Noise. Tire noise may easily be mistaken for rear axle noise even though the noisy tires may be located on the front wheels. Tires which are worn unevenly or which have the surfaces of the non-skid divisions worn in sawtooth fashion are usually noisy, and may produce vibrations which seem to originate elsewhere in the vehicle. This is particularly true with low tire pressure. Some desgins of non-skid treads may be more noisy than others, even when tires are new.

(3) Test for Tire Noise. Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure, for test purposes only, will materially alter noise caused by tires, but will not affect noise caused by the rear axle. Rear axle noise usually ceases when coasting at speeds under 30 miles per hour; however, tire noise continues but with lower tone as car speed is reduced. Rear axle noise usually changes when comparing drive and coast, but tire noise remains about the same.

(4) Front Wheel Bearing Noise. Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing drive and coast. Light application of brake while holding car speed steady will often cause wheel bearing noise to diminish as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, also by shaking wheels to determine if bearings are loose.

(5) Engine and Transmission Noises. Sometimes a noise which seems to originate in the rear axle is actually caused by the engine or transmission. To determine which unit is actually causing the noise, observe approximate car speeds and conditions under which the noise is most pronounced; then stop car in a quiet place to avoid interfering noises. With transmission in neutral, run engine slowly up and down through engine speeds corresponding to car speed at which the noise was most pronounced. If a similar noise is produced with car standing, it is caused by the engine or transmission and not the rear axle.

b. Rear Axle Noises

If a careful test of the car shows that the noise is not caused by external items as described in subparagraph a, it is then reasonable to assume that the noise is caused by the rear axle assembly. The rear axle should be tested on a smooth level road to avoid road noise. It is not advisable to test rear axle for noise by running with rear wheels jacked up.

Noises in the rear axle assembly may be caused by faulty propeller shaft or rear wheel bearings, faulty differential or pinion shaft bearings, misalignment between two U-joints, worn differential side gears and pinions, or by a mismatched, improperly adjusted or scored ring and pinion gear set.

(1) Rear Wheel Bearing Noise. A rough rear wheel bearing produces a vibration or growl which continues with car coasting with transmission in neutral. A brinelled rear wheel bearing causes a knock or click approximately every two revolutions of rear wheel since the bearing rollers do not travel at the same speed as the rear axle and wheel. Jack up rear wheels and spin by hand while listening at hubs for evidence of rough or brinelled wheel bearing.

(2) Differential Side Gear and Pinion Noise. Differential side gears and pinions seldom cause noise since their movement is relatively slight on straight ahead driving. Noise produced by these gears will be most pronounced on turns.

(3) Pinion Bearing Noise. Rough or brinelled pinion bearings produce a continuous low pitch whirring or scraping noise starting at relatively low speed.

(4) Ring and Pinion Gear Noise. Noise produced by the ring and pinion gear set generally shows up as drive noise, coast noise, or float noise.

(a) Drive noise is most evident on constant acceleration through the speed range.

(b) Coast noise is most evident when car is allowed to coast through the speed range with throttle closed.

(c) Float noise is most evident while just barely holding the car speed constant on a level road at any given speed.

(d) Drive, coast, and float noises will be very rough and irregular if the differential or pinion shaft bearings are rough, worn, or loose, and will vary in tone with speed.

c. Check for Propeller Shaft Vibration

Objectionable vibrations at high speed (65 MPH or higher) may be caused by a propeller shaft that is out of balance. Out of balance may be caused by a bent shaft.

To determine whether the propeller shaft is causing vibration, drive car through the speed range and note car speed at which vibration is most pronounced. Shift transmission into low range and drive car at same engine speed as when vibration was most pronounced in direct drive, and note the effect on vibration.

To determine the required engine speed, divide car speed by the transmission gear ratio, using 2.48 for automatic. Example: if vibration is most pronounced at 65 MPH in direct drive, the same engine speed would be produced in low range at $\frac{62}{2.48}$ = 26 MPH.

If the vibration is still present at the same engine speed whether in direct drive or in the lower gear, then the propeller shaft is not out of balance. If the vibration decreases or is eliminated in the lower gear, then the propeller shaft is out of balance and should be removed for correction.

d. Oil Leaks

It is difficult to determine the source of some oil leaks. When there is evidence of an oil leak at these locations, the probable cause is as follows:

(1) A leak coming from the bottom edge of the brake backing plate is caused by either a leaking wheel bearing seal or a leaking brake cylinder. The feel and smell of the leaking oil will help determine the type leak to expect.

(2) Oil coming from between the rear pinion flange slinger and the carrier is caused by a leaking pinion seal. Oil coming out around the pinion nut is caused by a defective "O" ring seal between the drive pinion and the pinion flange.

Even after the point of leakage has been determined, it is hard to tell whether the oil is leaking past the lip of the seal or past the O.D. of the seal. Therefore it is a good idea to make sure the leak is stopped by using a non-hardening sealing compound around the O.D. of the new seal.

SECTION 6-B

REAR AXLE SERVICE PROCEDURES

CONTENTS OF SECTION 6-B

6-4 REMOVAL AND INSTALLATION OF REAR AXLE ASSEMBLY

It is not necessary to remove the rear axle assembly for any normal repairs. The axle shafts and the carrier assembly can easily be removed from the car, leaving the rear axle assembly in place. However, if the housing is damaged, the rear axle assembly can be removed and installed using the following procedure.

a. Removal of Rear Axle Assembly

1. Raise rear of car and support securely using car stands under both frame side rails.

2. Mark rear universal joint and pinion flange for proper reassembly. Disconnect rear universal joint by removing two U-bolts. (On 4700, mark flanged ball stud yoke and rear pinion flange for proper alignment at reassembly. Then disconnect rear CV joint from rear axle by removing four pinion flange bolts.) Push rear propeller shaft forward as far as possible, then wire it to the upper control arm frame bracket to support it out of the way.

3. Disconnect brake hose at support bracket. Cover hose and brake pipe openings to prevent entrance of dirt.

4. Disconnect parking brake cables by removing adjusting nut and sheave. Unclip each cable at two places, disengage from guides, pull each cable free and lay-out forward from rear wheels.

5. Place a jack under center of rear axle housing and raise until shock absorbers are compressed slightly. Disconnect shock absorbers at lower ends.

6. Disconnect track bar at axle ends.

7. Disconnect upper control arm at axle end.

8. Lower jack slightly and disconnect lower control arms at axle end.

9. Lower jack from under axle housing and remove.

10. Roll rear axle assembly out from under car.

b. Installation of Rear Axle Assembly

1. With car resting securely on stands under frame, roll rear axle assembly into place.

2. Place a jack under center of axle housing and raise until aligned with lower control arms. Install lower control arm bolts and nuts. Torque nuts to 95 ft. lbs.

3. Raise jack slightly and connect upper control arm to axle housing. Torque nuts to 95 ft. lbs.

4. Connect track bar to axle housing. Torque nut to 120 ft. lbs.

5. Connect shock absorber lower ends. Torque nuts to 40 ft. lbs.

6. Install parking brake cables through clips and guides. Install sheave and adjusting nut.

7. Adjust parking brake according to procedure in paragraph 9-8.

8. Connect brake hose at support bracket and lock in place with yoke.

9. Bleed both rear wheel cylinders as described in paragraph 9-6.

10. Connect rear universal joint to pinion flange according to alignment marks. Compress bearings using a C-clamp so that bearing snap rings will engage pinion flange without gouging. See Figure 6-70. (On 4700, connect flanged ball stud yoke and rear pinion flange according to alignment marks.)

11. Torque U-bolt nuts to 13 ft. lbs. using an extension such as J-9113 (this corresponds to 15 ft. lbs. without an extension). See Figure 6-71. (On 4700, torque 4 pinion flange bolts to 75 ft. lbs.).

12. With car approximately level, fill rear axle housing to filler plug hole using specified gear lubricant. If axle housing or any rear suspension parts were replaced due to damage, rear universal joint angle must be checked and adjusted as required. See paragraph 6-19.

6-5 REMOVAL AND INSTALLATION OF AXLE SHAFT, WHEEL BEARING, OR OIL SEAL

a. Remove Axle Shaft Assembly

1. Place car stands solidly under rear axle housing so that wheels are clear of floor.

2. Remove rear wheel and brake drum. Both left and right side wheel bolts have right hand threads.

3. Remove nuts holding wheel bearing retainer plate to brake backing plate, leaving bolts in place to support backing plate.

4. Pull out axle shaft assembly using Puller J-6176 with a slide hammer. See Figure 6-5. CAUTION: While pulling axle shaft out through seal, support shaft carefully in center of seal to avoid cutting seal lip.

5. Replace two opposite retainer nuts finger tight to hold brake plate in position.

b. Remove and Install Rear Wheel Bearing

The rear wheel bearing and the bearing retaining ring both have a heavy press fit on the axle shaft. Because of this fit, they should be removed or installed separately.

1. Notch wheel bearing retaining ring in 3 or 4 places with a chisel. See Figure 6-6. Retaining ring will expand so that it can be slipped off. CAUTION: Axle shaft may be nicked if ring is cut completely through.

2. Press wheel bearing off, using Remover J-6525 either in a press or in a set-up using Ram and Yoke Assembly J-6180 and Adapter J-6258 as shown in Figure 6-7.

3. Install bearing retainer plate. Press new wheel bearing and re-

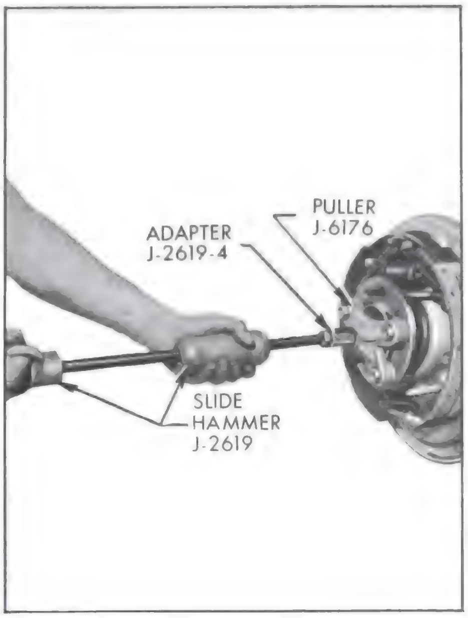


Figure 6-5—Removing Rear Axle Shaft

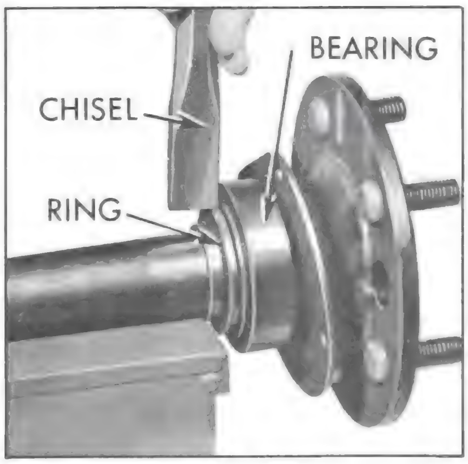


Figure 6-6—Removing Rear Wheel Bearing Retaining Ring

taining ring against shoulder on axle shaft using Installer J-9739 either in a press or in a set-up using Ram and Yoke Assembly J-6180 and Holder J-6407 shown in Figure 6-8. CAUTION: Bearing retainer plate must be on axle shaft before bearing is installed; retainer gasket can be installed after bearing.

c. Remove and Install Axle Shaft Oil Seal

The oil seal is located inboard of the wheel bearing with its O.D. tight in the rear axle housing and its sealing lip contacting a ground surface of the axle shaft. See Figure 6-2. Before removing, install 2 nuts finger tight to retain backing plate to axle housing. This protects the brake lines.

1. To remove oil seal, insert Puller J-6199 just through seal and expand. Pull seal with a slide hammer. See Figure 6-9.

2. Before installing apply sealer to O.D. of new seal.

3. Position seal over Installer J-9740 and drive seal straight into housing until installer bottoms against wheel bearing shoulder. See Figure 6-10.

d. Remove and Install Rear Wheel Bolt

1. To remove and install a rear wheel bolt, axle shaft assembly must be out of car. Remove rear wheel bolt by pressing from axle flange.

2. Install new rear wheel bolt by pressing through axle flange. Check new bolt for looseness; if bolt can be moved at all with fingers, axle shaft must be replaced.

e. Install Axle Shaft Assembly

Rear axle shafts are not interchangeable between sides; the right shaft is longer than the left.

1. Apply a coat of wheel bearing grease in wheel bearing recess of housing. Install new outer retainer plate gasket over retainer bolts.

2. Apply gear lubricant to the bearing surface and splines at the inner end of the axle shaft. Apply a coat of wheel bearing grease on the seal surface of the shaft to approximately 6 inches inboard of the shaft. Install axle shaft

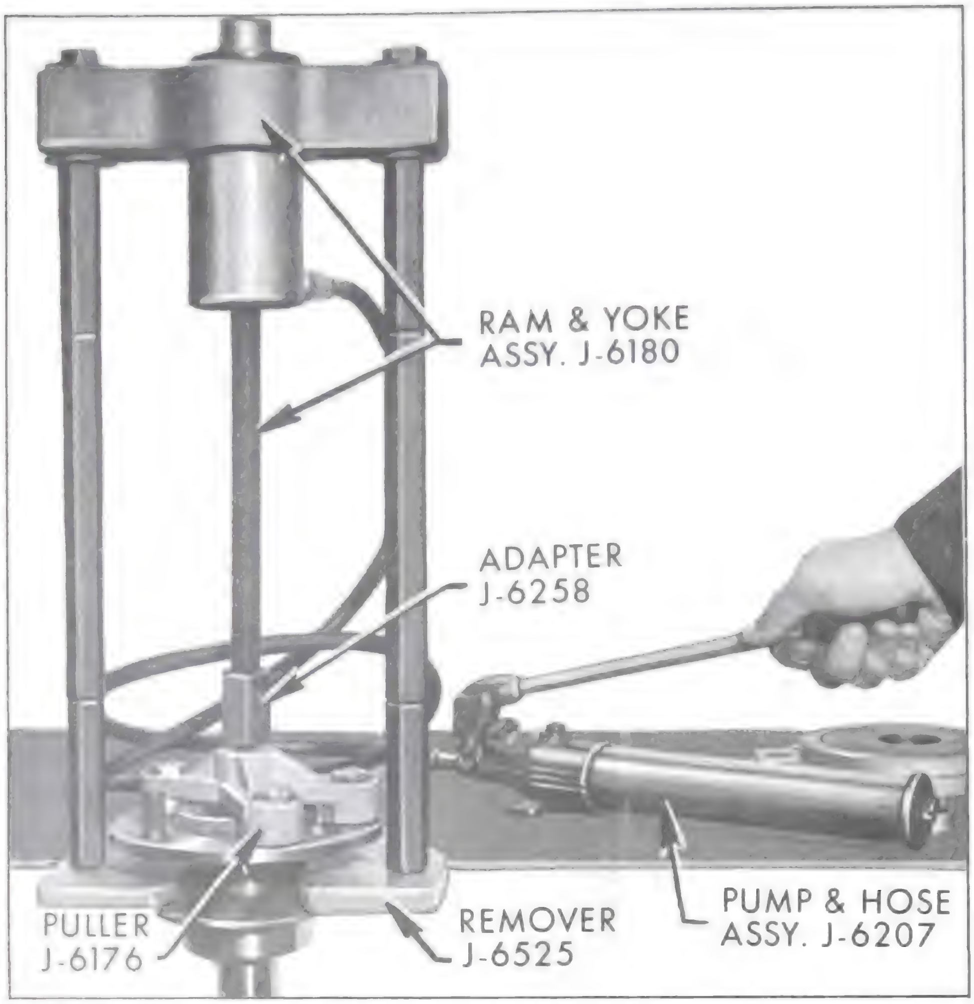


Figure 6-7—Removing Rear Wheel Bearing

through seal carefully to avoid cutting seal lip. Drive shaft into position. NOTE: If the axle to be installed is a positive traction axle, ONLY POSITIVE TRACTION LUBRICANT SHOULD BE USED.

3. Install retainer nuts and torque to 50 ft. lbs.

4. Install drum and wheel. Torque lug nuts to 70 ft. lbs.

6-6 REMOVAL AND INSTALLATION OF CARRIER ASSEMBLY

a. Remove Carrier Assembly

1. Raise rear of car and support securely under rear axle housing.

2. Mark rear universal joint and pinion flange for proper alignment at reassembly. Then disconnect rear universal joint by removing two U-bolts. (On 4700, mark flanged ball stud yoke and rear pinion flange for proper alignment at reassembly. Then disconnect rear CV joint by removing 4 pinion flange bolts.) Push rear propeller shaft forward as far as possible, then wire it to the upper control arm frame bracket to support it out of the way.

3. Remove rear wheels and brake drums. Remove axle shaft assemblies as described in paragraph 6-5.

4. Remove carrier to axle housing nuts except two opposite nuts; back these two nuts out until they engage only a few threads.

5. Locate a drain pan under carrier flange, then move carrier forward to drain gear lubricant.

6. Remove carrier assembly using a transmission jack, if available.

b. Install Carrier Assembly

1. Clean gasket surface of rear axle housing. Apply gasket cement and install new gasket. Make sure mounting surface of carrier is clean and free of any burrs or nicks.

2. Raise carrier assembly with a transmission jack, if available. Install carrier on axle housing. Torque nuts to 50 ft. lbs.

3. Install axle shaft assemblies as described in paragraph 6-5. Install rear drums and wheels. Torque lug nuts to 70 ft. lbs.

4. Connect rear universal joint to pinion flange according to alignment marks. Compress bearings using a C-clamp so that bearing snap rings will engage pinion flange without gouging. See Figure 6-70. (On Riviera, connect flanged ball stud yoke and rear pinion flange according to alignment marks.)

5. Torque U-bolt nuts to 13 ft. lbs. using an extension such as J-9113. See Figure 6-71. (On Riviera torque 4 pinion flange bolts to 75 ft. lbs.).

6. With car approximately level, fill rear axle housing to filler plug hole using specified lubricant.

6-7 DISASSEMBLY OF CARRIER ASSEMBLY

a. Removal and Disassembly of Ring Gear and Case Assembly

1. Place carrier assembly in suitable mounting fixture such as Fixture J-6177.

2. It is advisable to check the existing gear lash with a dial indicator as described in paragraph 6-8, e. This will indicate gear or bearing wear or an error in backlash or preload setting which will help in determining cause of axle noise. It will also enable used gears to be reinstalled at original

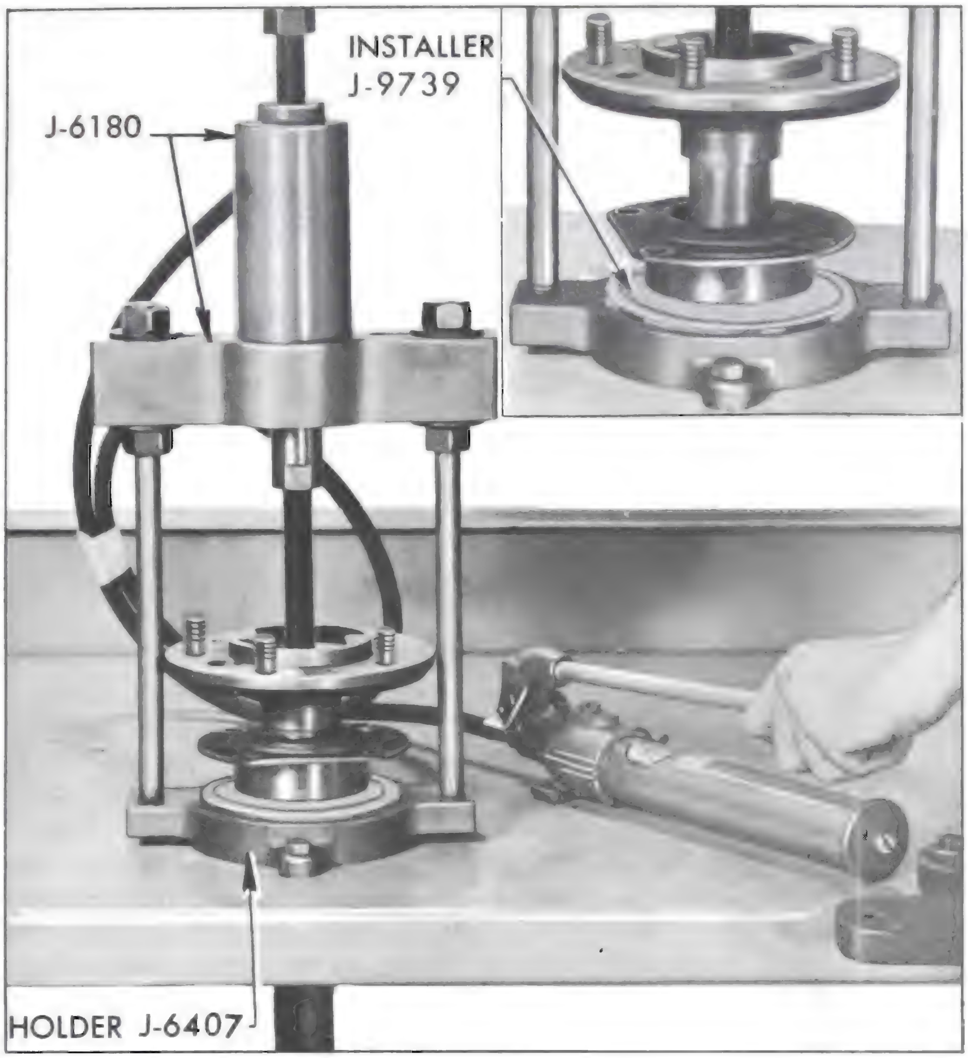


Figure 6-8—Installing Rear Wheel Bearing or Retaining Ring

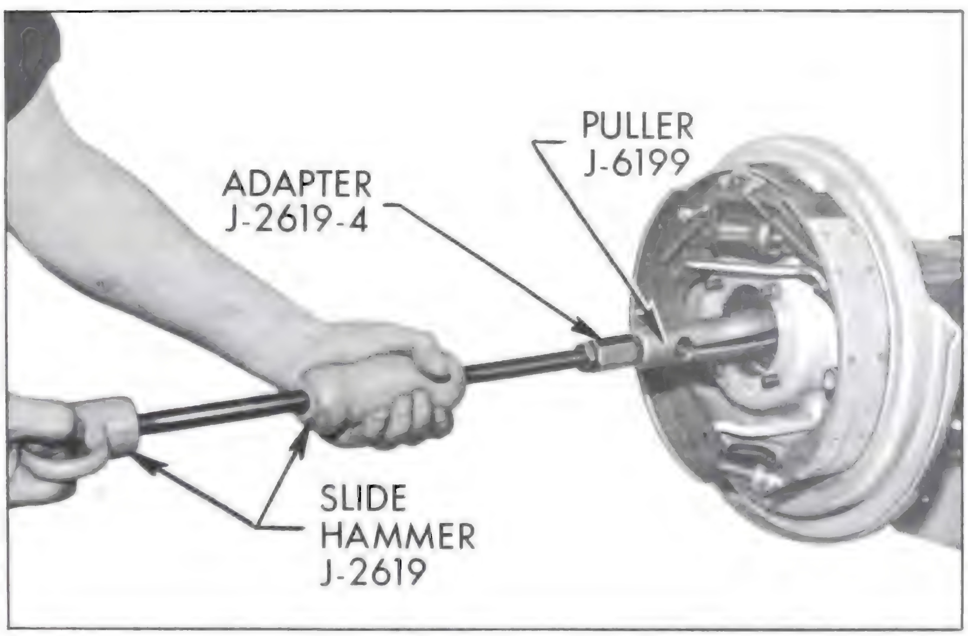


Figure 6-9—Removing Axle Shaft Oil Seal

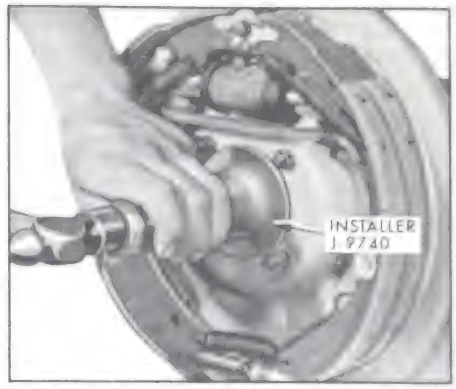


Figure 6-10—Installing Axle Shaft Oil Seal

lash setting to avoid changing gear tooth contact.

3. Remove differential bearing pedestal clamp bolts and open pedestals by tapping a wedge in each pedestal slot.

CAUTION: Do not use excessive force on wedges as pedestal bores may be permanently distorted.

4. Pull differential bearing supports with Puller J-9744-1 using the following procedure:

(a) Using a screwdriver, turn expanding screw in puller body, J-9744-5 in a counterclockwise direction to retract pins, then insert puller body into differential bearing support until reference line on tool is flush with end of support and punch mark is in general direction of hole in support. See Figure 6-11.

Figure 6-11—Installing Support Puller

(b) Expand pins a slight amount by turning expanding screw with screwdriver in a clockwise direction until a light drag on pins is felt, then move tool as required to engage pins with holes in support. Fully expand pins.

(c) Place bridge J-9744-2 over puller complete with draw bolt, thrust bearing, and washer as shown in Figure 6-12. With a suitable wrench tighten bolt to withdraw bearing support.

5. Install Spreader J-6185 shown in Figure 6-34. Tighten spreader bolt just enough to free case assembly.

CAUTION: Do not spread pedestals any farther than necessary or they may be permanently sprung.

Lift case straight out until side bearings are half-way clear of pedestals. Then take hold at bearings with both hands to prevent bearings from dropping and lift case assembly out. Keep right and left bearings, shims, and supports in sets so that they may be reinstalled in the same positions. Remove spreader tool.

6. Mark ring gear and case, so they may be reassembled in same relative position. Remove ring gear from case. If ring gear is tight, tap it off using a soft hammer; do not pry between ring gear and case.

7. Drive differential pinion axle spring pin and pinion axle from case. Mark side gears, pinions, and washers so they may be reinstalled in same sides. Remove side gears, pinions, and washers.

8. If a differential bearing is to be replaced, pull bearing outer race from case with Remover J-6552 using the following procedure: (See Figures 6-13 and 6-14).

(a) Insert puller jaws with lips down under edge of outer race.

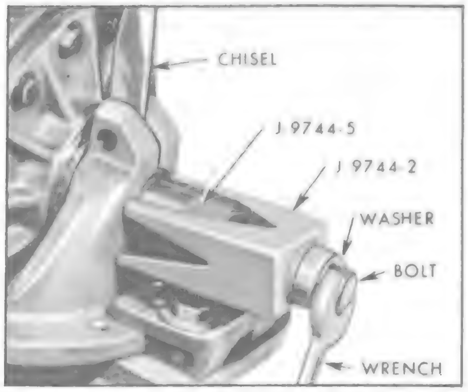


Figure 6-12—Removing Differential Bearing Support

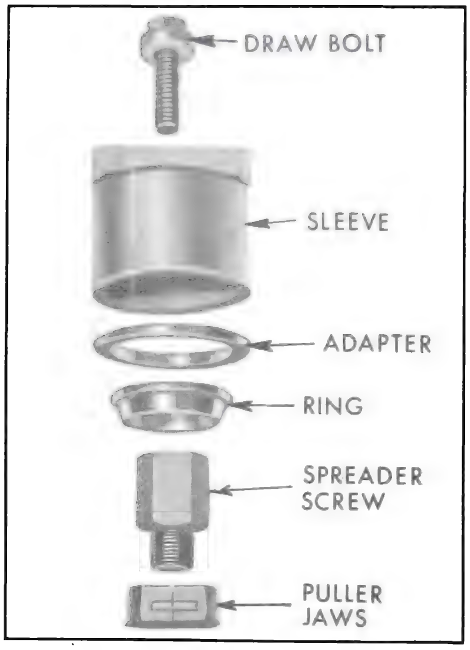


Figure 6-13—Proper Position of J-6552 Parts

(b) Carefully thread spreader screw into jaws, making sure that threads are not crossed. Leave spreader screw one full turn away from jaws.

(c) Place retainer ring and adapter over jaws, tapping them down while pulling up spreader screw so that ring fits snugly around jaws; then turn spreader screw tightly against jaws.

(d) Place sleeve over assembled tool. Insert draw bolt through washer, thrust bearing and sleeve. Then thread it into spreader screw and pull bearing outer race.

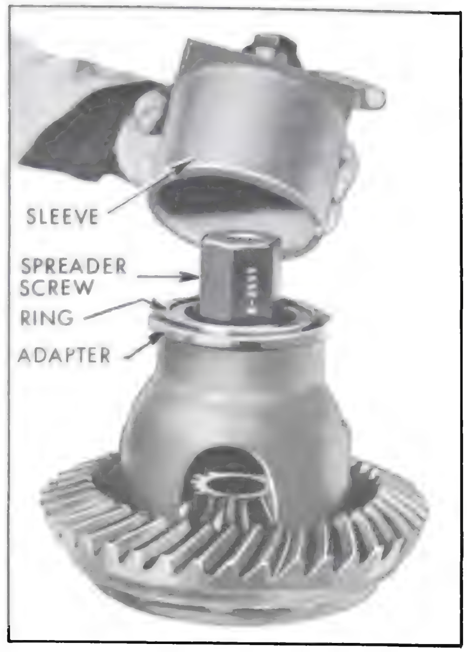


Figure 6-14—Installing Sleeve to Remove Bearing Outer Race

b. Removal of Pinion and Bearings

1. Check pinion preload as described in paragraph 6-8. If there is no preload reading, check for looseness of pinion assembly by shaking. Any noticeable looseness indicates worn or defective bearings, requiring replacement. If run long with very loose bearings, ring and pinion gears will be damaged and also need replacing.

2. Install Holder J-8614-01 on pinion flange using two 5/16-18 x 2 bolts with flat washers. (On 4700, install Holder J-8614-01 on pinion flange using Adapters J-21619.) Remove pinion nut using a 5/16 (3/4 drive) socket on Handle J-6246. Remove washer. See Figures 6-15 and 16.

NOTE: Because of differences in castings, it may be necessary to file out slightly slotted bolt holes in holder in order to accommodate J-21619 Adapters.

3. Pull flange from pinion using Puller J-8614-02 in Holder J-8614-01. (On 4700 use Puller J-8614-02 in Holder J-8614-01 with Adapters J-21619.) To install puller, back out puller

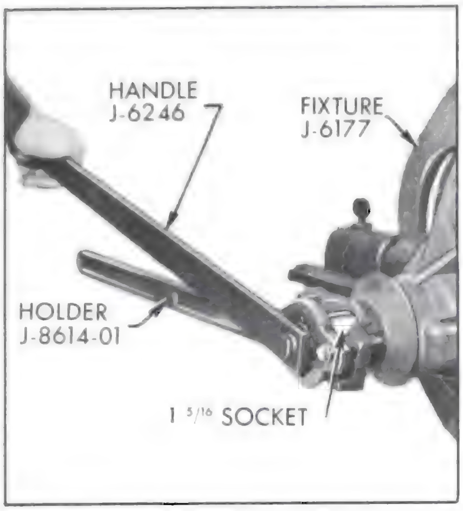


Figure 6-15—Removing Pinion Nut

screw, insert puller through holder, and rotate 1/8 turn. See Figures 6-17 and 18.

4. As pinion flange is removed, hold hand under pinion to catch it, as it may fall through. Remove "O" ring seal from pinion. If necessary, tap pinion out with a soft hammer, being careful to guide pinion with hand to avoid damage to bearing outer races.

5. If rear pinion bearing is to be replaced or pinion depth setting is to be changed, remove rear bearing from pinion shaft using Remover J-9746 and Holder J-6407 in a press, or in a set-up using Ram and Yoke Assembly J-6180 as shown in Figure 6-20.

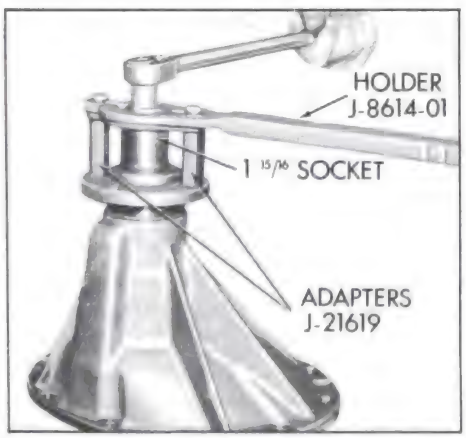


Figure 6-16—Removing Pinion Nut - 4700

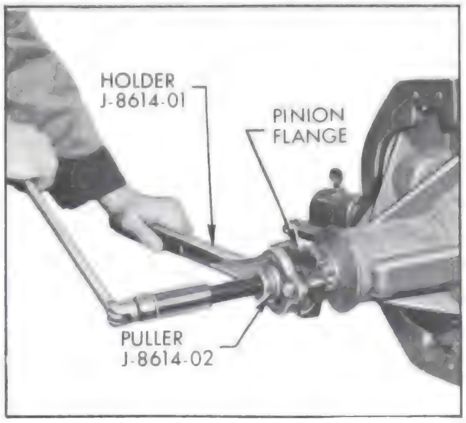


Figure 6-17—Removing Pinion Flange

6. Pry pinion oil seal from carrier, being careful not to damage front pinion bearing. If front pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose.

7. If rear pinion bearing is to be replaced, drive outer race from carrier using a drift in slots provided for this purpose.

6-8 ASSEMBLY OF CARRIER ASSEMBLY

Before installation of any parts, examine the wearing surfaces of all parts for scoring or unusual wear. Make certain that the interior of the carrier housing is absolutely clean and dry. Also make certain that the parts to be assembled are absolutely clean and that there are no burred edges. Lubricate all parts with the specified rear axle lubricant just before assembly.

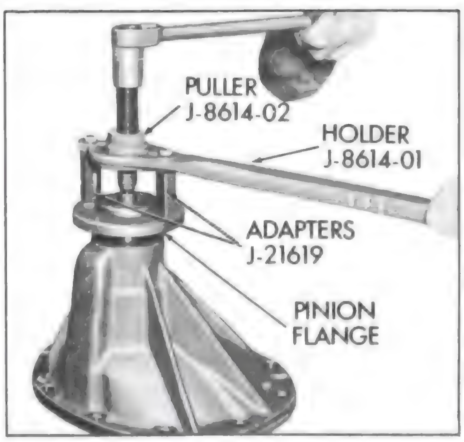


Figure 6-18—Removing Pinion Flange - 4700

Figure 6-19—Installing Pinion Bearing Remover

Figure 6-20—Removing Rear Pinion Bearing

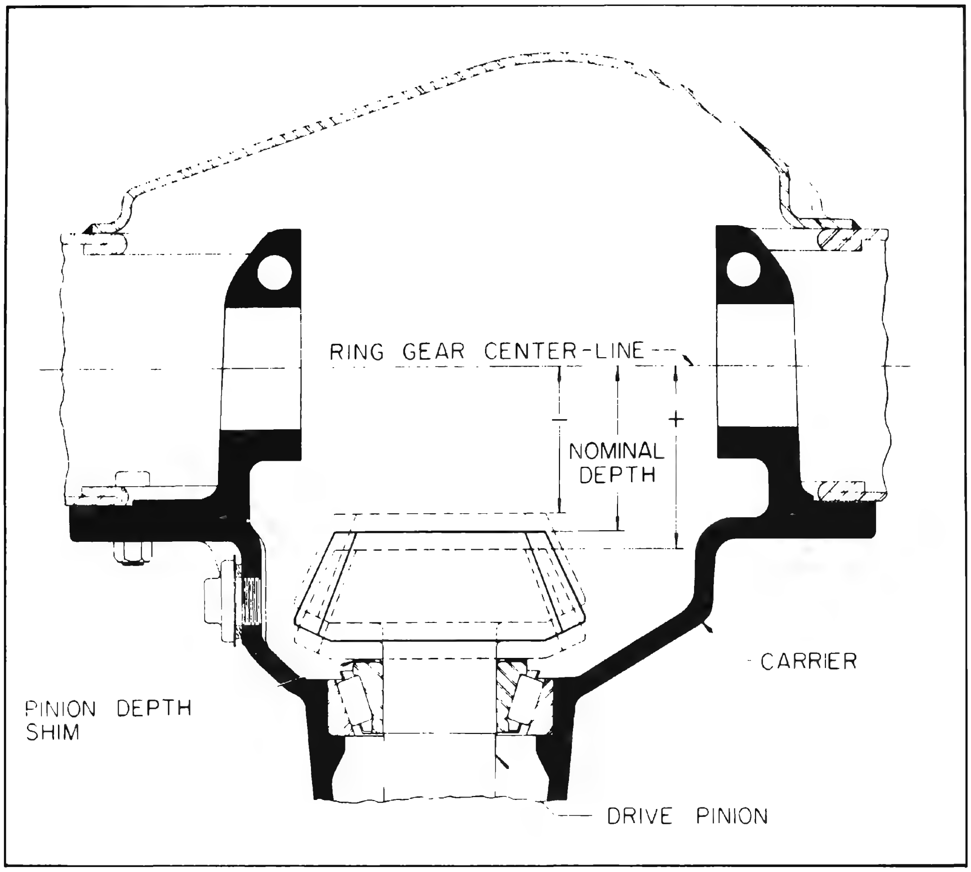


Figure 6-21—Nominal Pinion Setting Depth

NOTE: If the Buick is equipped with a Positive Traction Differential, only Positive Traction Lube should be used.

CAUTION: If the ring gear and pinion are changed, only factory hypoid lubricant should be used for filling because of its special anti-scoring properties. For this reason the proper lubricant is included in the carton with the replacement gears as received from the Buick warehouses. See paragraph 1-9.

a. Pinion Setting Marks and Setting Gauges

All Buick ring and pinion gear sets are selectively matched for best operating position and proper tooth contact. After matching, a serial number is etched on both the pinion and the ring gear to aid in keeping matched parts together. Parts having different serial numbers must never be used together.

Ring and pinion gear sets are matched in a special test machine which permits adjustment of pinion depth in ring gear until a point is reached where best operation and proper tooth contact under load is obtained. At this point, the setting of the pinion with reference to the centerline of the ring gear is indicated by the machine. This setting may vary slightly from the design or "nominal" setting due to allowable variation in machining the parts.

All production pinions are marked to indicate the variations in thousandths of an inch over or under the "nominal" setting. When a pinion is marked "+" (plus), it means that the pinion, when installed in the carrier, must be at a given distance from the centerline of the side pedestals plus the amount indicated on the pinion to position it at the nominal setting. When a pinion is marked "-" (minus), it means that it must be located at the given distance minus the amount marked on the pinion to position it at the "nominal" setting. See Figure 6-21.

All service pinions are "nominal" or zero pinions and are therefore unmarked. These service pinions are set directly at a given distance from the centerline of the side pedestals.

Pinion Setting Gauge J-5647 with Adapter J-5647-35, Adapter J-5647-34, Pilot J-5647-37, Gauge Plate J-5647-36, and Stud and Nut Assembly J-8619-13 is used to set pinion depth. See Figure 6-22. It is not necessary to reassemble and install the pinion to determine the correct pinion depth shim since the pinion depth setting gauge arrangement provides in effect, a nominal or zero pinion as a gauging reference.

b. Checking Pinion Depth

NOTE: Before setting pinion depth, the pinion bearing races must be in position and the pinion oil seal must be removed. Install races following instructions in subparagraph c., Steps 1 and 2.

1. Be certain that all parts in pinion setting gauge are clean.

2. Install the disks on the indicator gauge. Install the small contact button on the stem of the dial indicator and mount the dial indicator on the indicator gauge.

3. Place the indicator gauge on the master gauge so that the spring-loaded center is engaged in the centering hole corresponding to the indicator pad "b". See Figure 6-22.

4. Center the indicator contact button on the specified contact pad and lock the indicator by tightening the thumb screw.

5. Hold gauge yoke down firmly with both disks contacting the horizontal and vertical pads on the

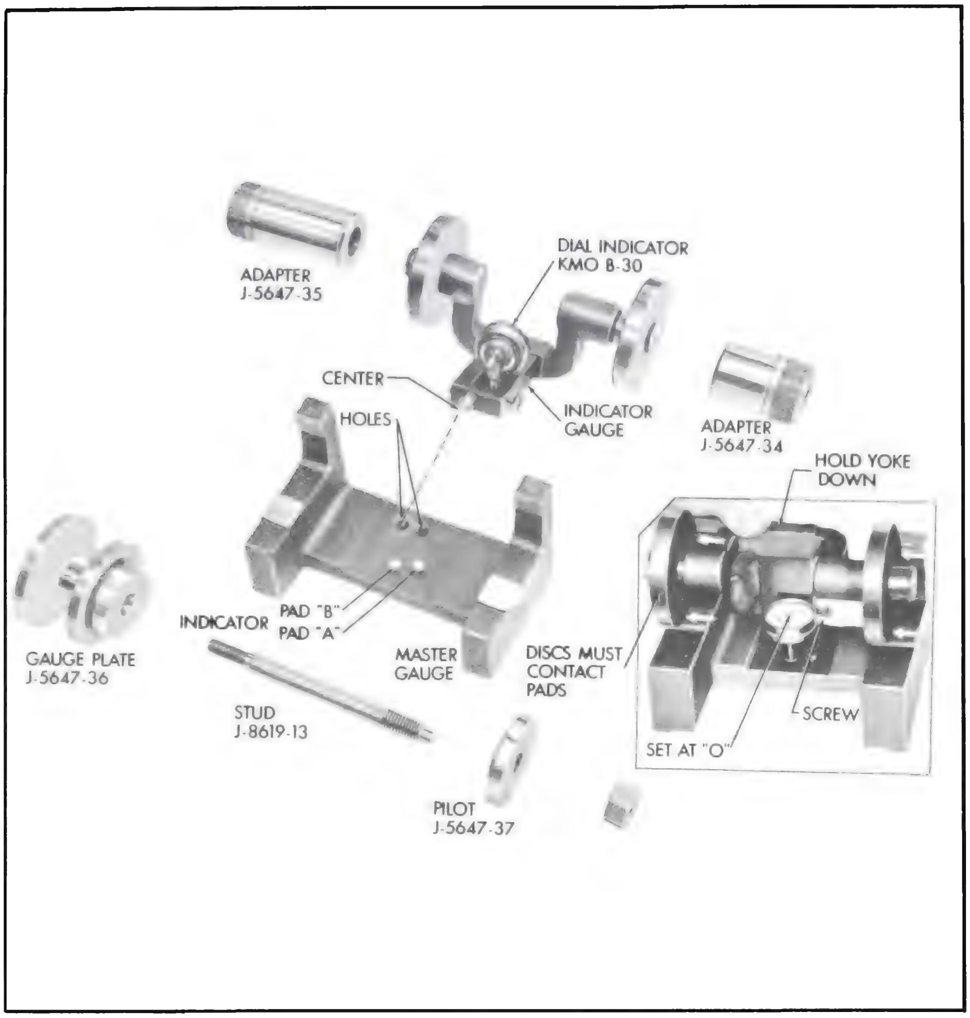


Figure 6-22—Pinion Setting Gauge J-5647 and Adapters

master gauge; set dial indicator at zero.

6. Lubricate front and rear pinion bearings which will be used in final reassembly, and position them in their respective races in the carrier. With bearings held in place in races, install Gauge Plate J-5647-36 on rear pinion bearing inner race, and place Pilot J-5647-37 on front pinion bearing with small diameter inside bearing race. Insert Stud J-8619-13 through pilot, and thread it into the gauge plate. See Figure 6-23.

7. Install nut on Stud J-8619-13. Hold stud stationary with wrench positioned on flats on end of stud; tighten nut until a reading of 20 inch pounds is obtained when rotating the gauge plate assembly with an inch pound torque wrench.

8. Be certain that differential support bores are free of burrs. Drive a wedge into each pedestal split and spread them just enough so that Adapters J-5647-35 and 34 can be inserted. Then place indicator gauge in carrier as follows: (See Figure 6-24.)

a. Remove disks from indicator gauge and hold it in position in the carrier with pins centered in the pedestal bores.

b. Slide long adapter through pedestal bore farthest from pinion and over gauge pin. Then slide short adapter in place on other side.

c. Position the spring-loaded pin of the indicator gauge in the centering hole of Gauge Plate J-5647-36, and position the contact button of dial indicator to bear against machined surface of Gauge Plate. See Figure 6-24.

9. Press gauge yoke down firmly. Record dial indicator reading, and then remove indicator gauge checking "zero setting" on master gauge to be certain this setting was not disturbed by handling. If "zero setting" is still correct, remove gauging set-up and both bearings from carrier.

10. Examine ring gear and pinion for nicks, burrs, or scoring. Any of these conditions will require replacement of the set.

11. The correct pinion shim to be used during pinion reassembly should be selected as follows:

(a) If a production pinion is being reused and pinion is marked "+" (plus), the correct shim will have a thickness equal to the indicator gauge reading found in Step 9 less the amount specified on the pinion.

(b) If a production pinion is being reused and the pinion is marked "-" (minus), the correct shim will have a thickness equal to the indicator gauge reading found in Step 9 plus the amount specified on the pinion.

(c) If a service pinion is being used (no marking), the correct shim will have a thickness equal to the indicator gauge reading found in Step 9.

c. Installation of Pinion Bearings and Pinion

1. Drive front pinion bearing outer race against shoulder on carrier using Replacer J-8611 with driver handle. See Figure 6-25.

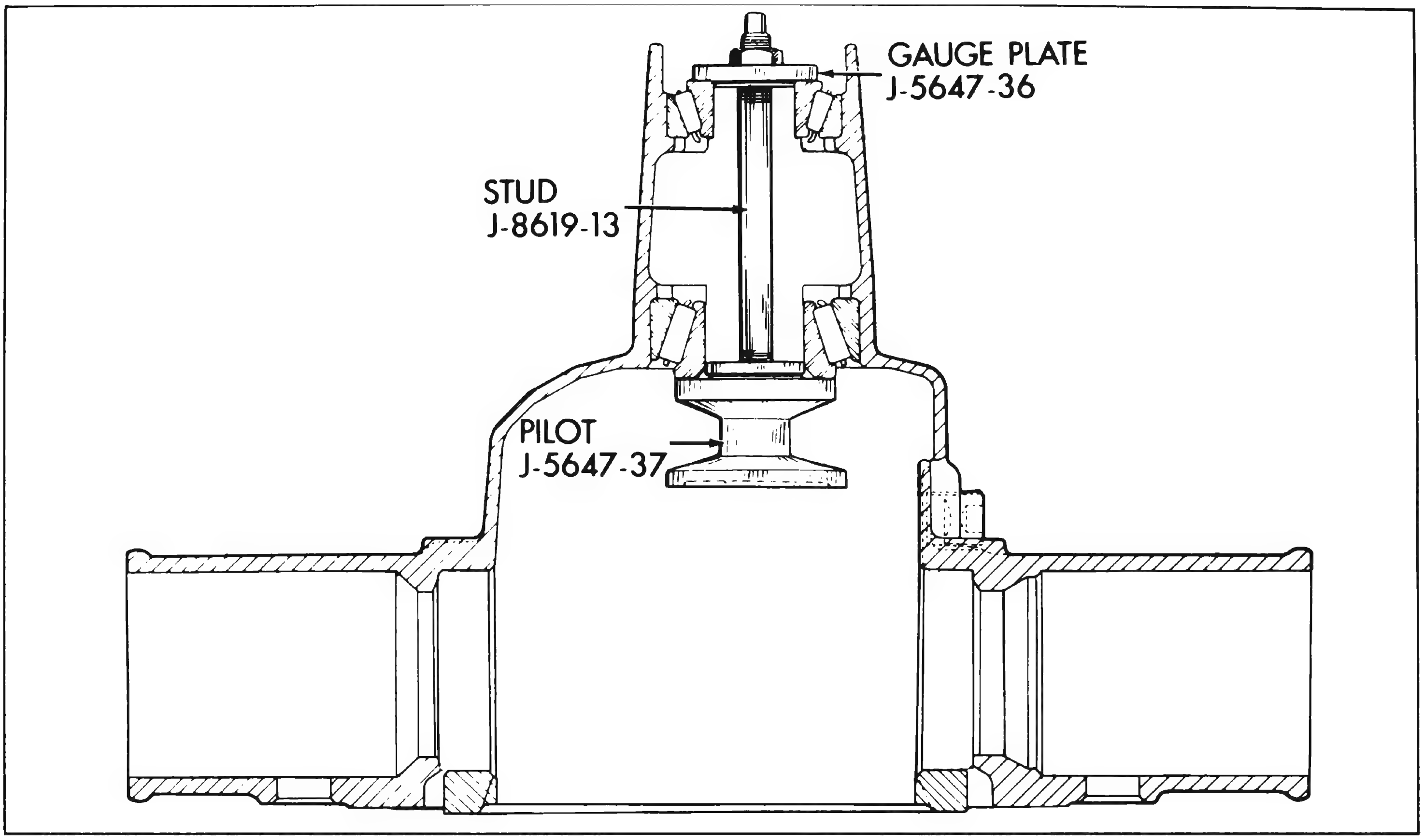


Figure 6-23—Installing Gauge Plate in Carrier

2. Drive rear pinion bearing outer race against shoulder in carrier using Replacer J-9745 with driver handle. See Figure 6-26.

3. Place correct shim (as determined in subpar. b) against head of pinion and install rear pinion bearing using Replacer J-6377 and Holder J-6407 with Ring J-6407-2 in a press or as shown in Figure 6-27.

4. For a starting pinion bearing preload adjustment, use original pinion preload spacers. Place these spacers on pinion and hold pinion assembly in position in carrier. Oil front pinion bearing and place in position on pinion. Hold pinion in place and drive front pinion bearing over pinion until fully seated using Installer J-21005. See Figure 6-28.

5. Install new "O" ring seal on pinion. Coat O.D. of new pinion seal with sealing compound and

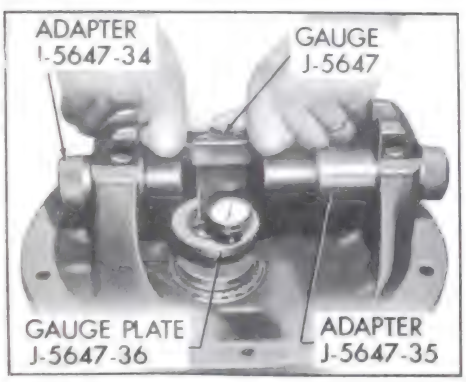


Figure 6-24—Checking Pinion Setting

Figure 6-25—Installing Front Pinion Bearing Outer Race

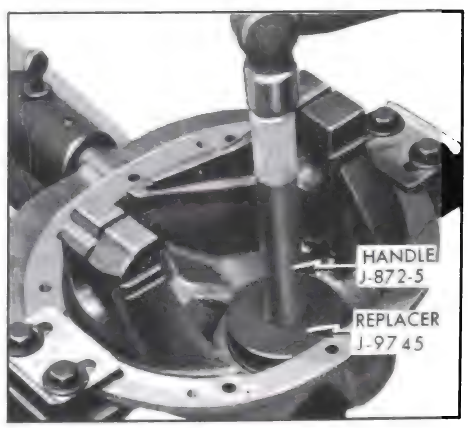


Figure 6-26—Installing Rear Pinion Bearing Outer Race

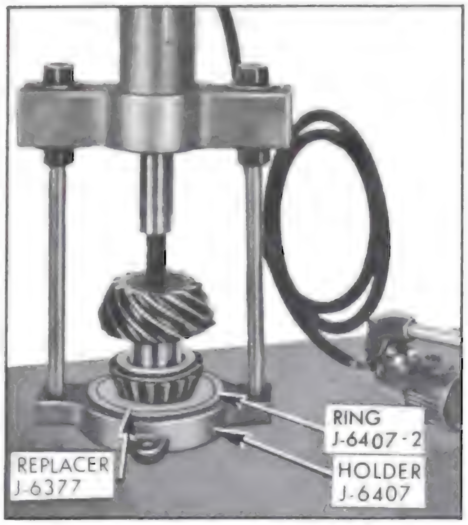


Figure 6-27—Installing Rear Pinion Bearing

install seal using Installer J-21005. See Figure 6-29.

6. Fill space between lips of oil seal with wheel bearing grease and apply a thin coat of the same grease on seal surface of pinion flange. Install pinion flange on pinion by tapping with a soft hammer until a few pinion threads project through the flange. Install pinion washer and nut. Hold pinion flange with Holder J-8614-01. (On 4700, hold pinion flange with Holder J-8614-01 and Adapters J-21619.) Torque pinion nut to 80 ft. lbs. using Torque Wrench J-1313 on outer end of Handle J-6246. (This amounts to an actual 250 ft. lbs. torque at nut.) See Figure 6-30.

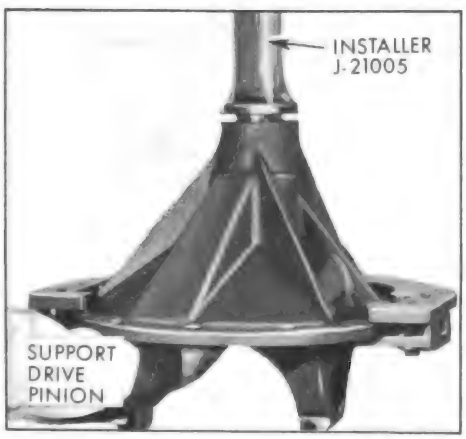


Figure 6-28—Installing Front Pinion Bearing

Figure 6-29—Installing Pinion Seal

7. Rotate pinion three or four times to seat bearings. Turn pinion slowly with an inch pound torque wrench; bearing preload including drag of new seal should be 15 to 35 inch pounds. See Figure 6-31.

If preload torque is low, reduce total pinion spacer thickness .001" for each added 10 in. lbs. preload needed; if preload is high, increase total pinion spacer thickness .001" for each 10 in. lbs. preload to be subtracted. These spacers are furnished to be used

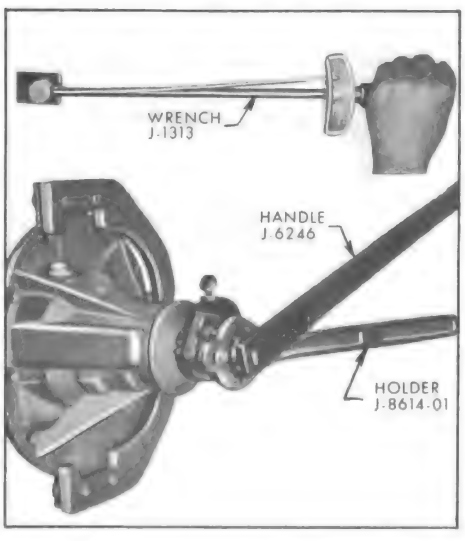


Figure 6-30—Tightening Pinion Nut

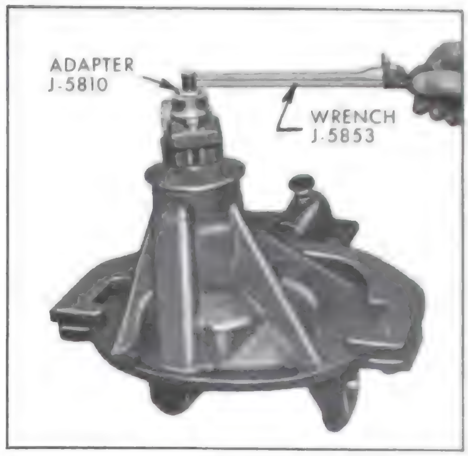


Figure 6-31—Checking Pinion Bearing Preload

in pairs so that possible thicknesses range from .400" to .470" by thousandths. Service spacers are marked with their thickness in thousandths.

d. Assembly of Differential Case, Gears and Bearings

1. Drive differential bearing outer races into case, using Replacer J-9742. See Figure 6-32.

2. Install side gears, pinions, and washers in case. If same parts are used, replace in original sides. Install pinion axle. Drive spring pin through hole in pinion axle until flush with case.

Figure 6-32—Installing Differential Bearing Outer Race

3. Check matching numbers on ring gear and pinion to make sure the two parts have not been mixed with another gear set.

4. After making sure that mating surfaces of case and ring gear are clean and free of burrs, bolt ring gear to case using three Studs J-6251 to align parts. See Figure 6-33. If same ring gear and case are used, line up marks so they are assembled in same relative positions.

Do not use lock washers or any substitute bolts.

5. First tighten bolts alternately on opposite sides of the case to 35 ft. lbs. torque, then tighten in the same manner to 70 ft. lbs.

e. Installation and Adjustment of Ring and Case Assembly

1. Before installation of ring gear and case assembly make sure that differential bearing and bearing support surfaces in carrier pedestals are clean and free of burrs. Remove any burrs which might prevent bearings or bearing supports from seating properly.

2. Place case assembly and differential bearings in position in carrier. If same bearings are used, install in original positions. Insert Support Tools J-9743 through the pedestal bores into the bearing inner races. Press tools toward each other to seat them, using hand pressure. If support tools are loose, install pedestal clamp bolts and nuts and tighten lightly until support tools can just be moved by twisting them. If support tools are too tight, loosen them as necessary by slightly wedging pedestals open with chisels. See Figure 6-34.

3. Rotate the differential assembly three or four times to seat bearing rollers, then manually adjust the whole assembly sideways to get .008" gear backlash. The assembly tools may be tapped lightly with a hammer to seat them. Check backlash as follows:

(a) Mount dial indicator as shown in Figure 6-35. Use a small button on indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that indicator stem is as nearly as possible in line with gear rotation and perpendicular to the tooth surface. If stem bears against edge of tooth, or stem is at considerable angle to the line of gear rotation, or at a considerable angle to face of the tooth, a false indication of backlash will be obtained.

(b) Check gear lash at three or four points around ring gear. Lash must not vary more than .003" around ring gear. If lash varies over .003" check for burrs, uneven bolting conditions, or distorted case flange, and make necessary corrections.

CAUTION: Any gear lash check must be made with pinion locked to carrier to be sure it cannot turn.

(c) Adjust gear lash at the point of minimum lash to .008" for all new gears. If original gear set is being reinstalled, the original lash should be maintained.

4. Measure with a shim between each bearing and its pedestal. Do not remove support tools for measuring. Select shim that measures .002" thicker than largest shim that can be inserted for each side; this should preload each differential bearing .002". These shims are furnished to be used singly in thicknesses ranging from .040" to .082" by two

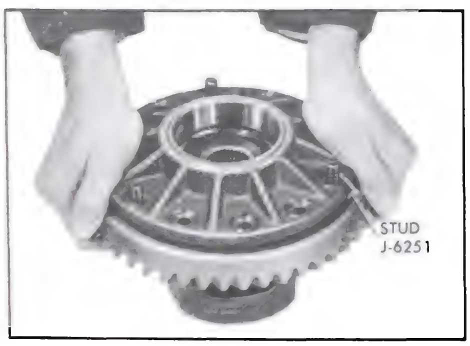


Figure 6-33—Installing Ring Gear on Differential Case

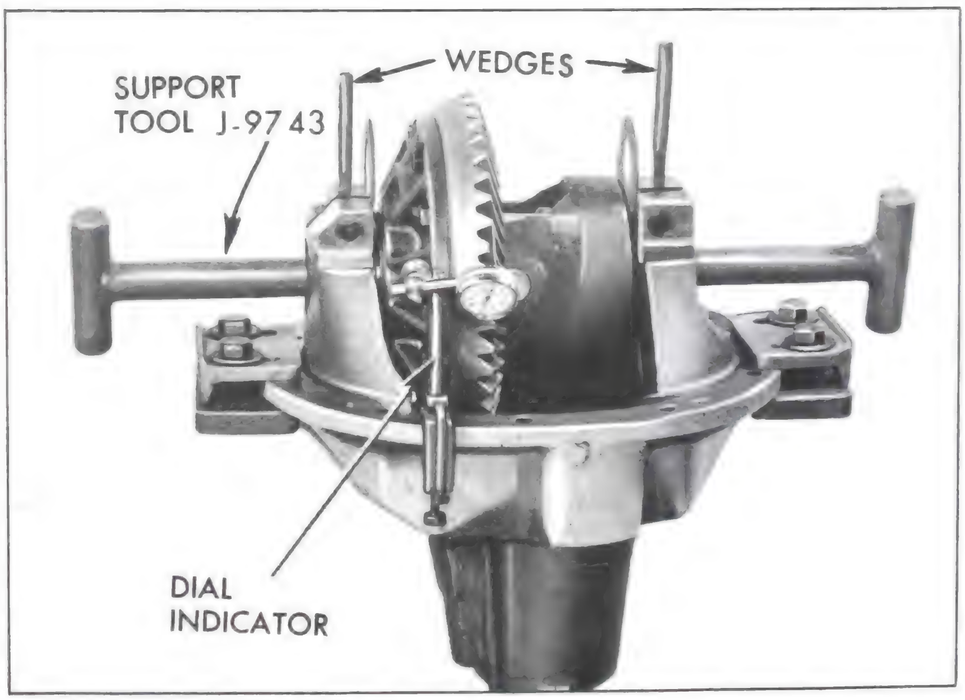


Figure 6-34—Positioning Differential for Correct Backlash

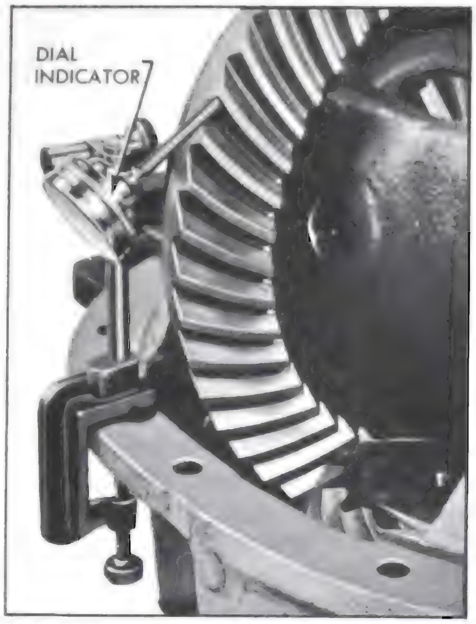


Figure 6-35—Checking Backlash with Dial Indicator

thousandths. Service shims are marked with their thickness in thousandths.

5. Remove support tool farthest from ring gear, insert shim for that side, and replace support tool.

6. Place other shim in position for insertion. While keeping a heavy hand pressure on shim, spread carrier pedestals just enough to start shim, using Spreader J-6185.

CAUTION: Do not spread pedestals any farther apart than is absolutely necessary to push differential shim into position. If pedestals are sprung too far, they may take a permanent set. See Figure 6-36. Leave support tool in position until after shim is started to keep case assembly from dropping out of line.

7. Remove left assembly tool and push shim into final position. Center it first with fingers through pedestal bore, then with a support tool. Remove spreader tool and pedestal wedges.

8. Lubricate support bushings with hypoid gear lubricant. Drive each differential bearing support into its pedestal until seated solidly in the bearing, using Support Tool J-9743. See Figure 6-37. Tighten pedestal clamp bolts and nuts to 50 ft. lbs.

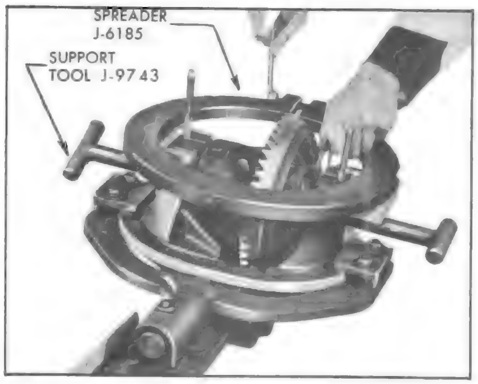


Figure 6-36—Installing Differential Bearing Shims

Figure 6-37—Installing Differential Bearing Supports

9. Recheck backlash as in Step 3. Final backlash must be .007"-.009" at point of minimum lash, with not more than .003" variation around gear.

10. Add lubricant and fill to level of filler plug opening to 1/4" below.

CAUTION: If the ring gear and pinion are changed only factory hypoid lubricant should be used for filling because of its special anti-scoring properties. For this reason the proper lubricant is included in the carton with the replacement gears as received from the Buick warehouses. See paragraph 1-9.

SECTION 6-C
POSITIVE TRACTION DIFFERENTIAL

CONTENTS OF SECTION 6-C

6-9 DESCRIPTION OF POSITIVE TRACTION DIFFERENTIAL

a. General Description

The Positive Traction (non-spin) Differential is optional equipment on all series Buicks. Its primary advantage is that it reduces the possibility of the car becoming stuck under adverse driving conditions. Unlike the conventional differential assembly, when one wheel is on a slippery surface the car will still move forward since both wheels are automatically locked together and rotating at the same speed, allowing the wheel on dry surface to provide the necessary traction.

A secondary advantage of the Positive Traction Differential is that bumps do not adversely effect rear wheel action. During power application, with a conventional differential, when one rear wheel hits a bump and bounces clear of the road, it spins momentarily. When this rapidly spinning wheel contacts the road again, the sudden shock may cause the car to swerve. This is also hard on the complete drive train and tires. With a non-spin differential, the free wheel continues rotating at the same speed as the wheel on the road, thereby minimizing the shock and its resulting swerve.

The Positive Traction Differential consists of a different type of differential case assembly which is used in place of the conventional case assembly. All rear axle parts are identical.

b. Operation

The Positive Traction Differential has pinion gears and side gears which operate in a manner similar to those in a conventional differential. However, behind each side gear is a side gear ring and a clutch pack whose function is to hold the side gears to the case under certain driving conditions, which in effect locks both axle shafts together to turn as one. In order to provide room to assemble these clutches the differential case is split into two halves (the ring gear flange half and the cover half) which bolt together.

The mechanism that actuates the clutches consists of four pinion gears positioned in the case on two cross shafts which are at right angles to each other. Both ends of the shafts have bevelled surfaces which mate with ramps in the case. See Figure 6-39.

Until force is applied to the differential case by the drive pinion and ring gear, the two cross shafts are down in the grooves in the differential case and the clutches are not applied. However, when force is applied upon acceleration with the weight of the vehicle proportionally on the rear wheels and the friction of the rear wheels against a surface, the side gears which are splined to the axles exert a force to the pinion gears and to the cross shafts forcing the cross shaft up the ramps in the case. When the cross shafts ride up the ramps they carry the pinion gears with them against the side gear ring forcing this against the clutch pack, thus compressing the clutch pack against the differential case and locking the two axles together.

Although one wheel may be slipping in mud, snow or on ice, there is usually enough friction on this slipping wheel to start the above process. In extreme cases such as wet ice, which is probably the slipperiest road surface one might encounter, there may not be enough friction on the slipping wheel to lock the axles together. This can be overcome by lightly applying the parking brake. This added resistance to the slipping wheel can cause the pinion shafts to climb their ramps and lock the axles together. This gives the wheel on solid ground sufficient power to pull the car away from the obstacle.

Each clutch pack consists of three clutch plates which are keyed to the differential case by external lugs, and two clutch discs which are splined internally to the side gear ring. The gear ring is splined to the side gear which is in turn splined to the axle shaft. Whenever a load is applied to the differential, each side gear ring is forced outward, squeezing its clutch pack against the differential case. See Figure 6-40.

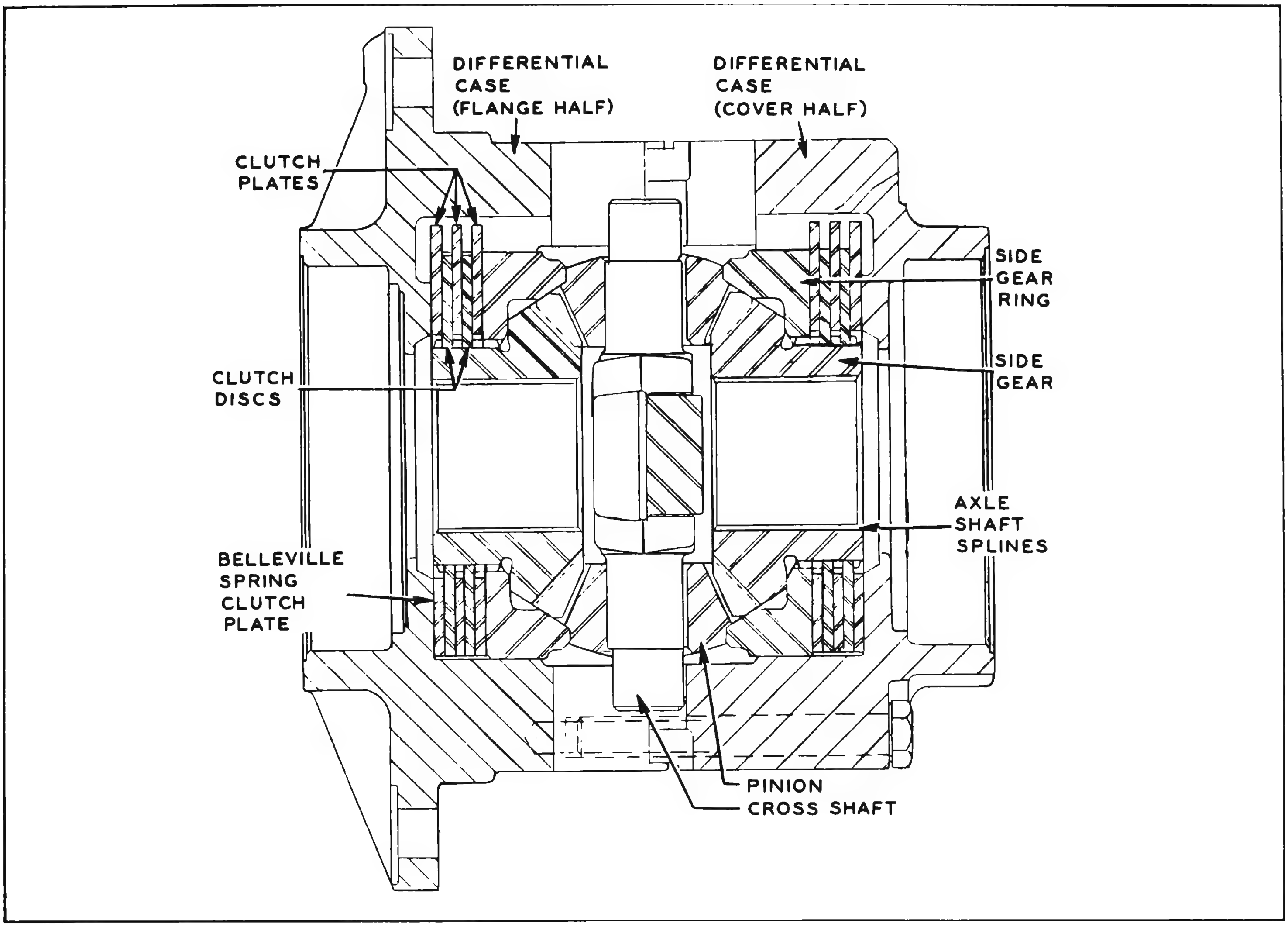


Figure 6-38—Positive Traction Differential

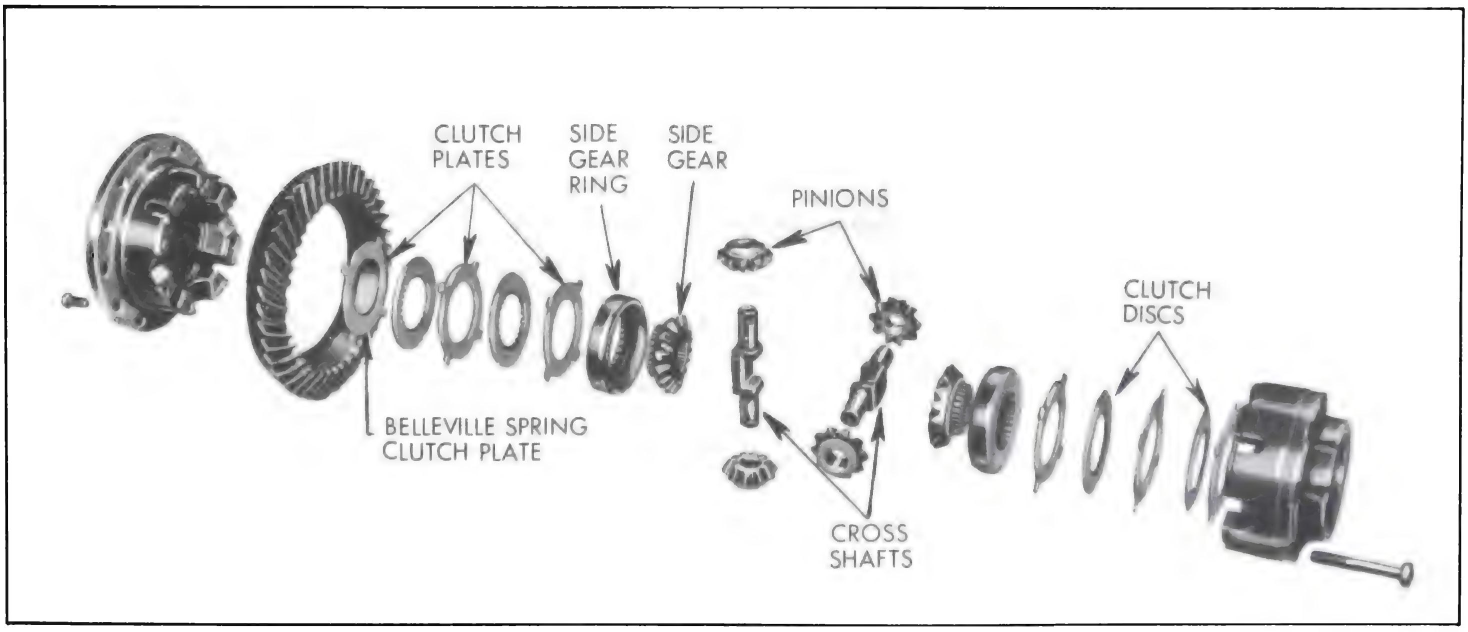


Figure 6-39—Positive Traction Differential - Exploded

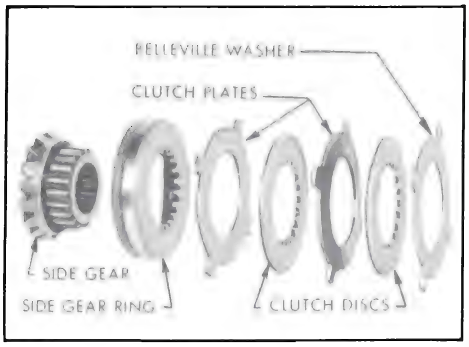


Figure 6-40—Clutch Pack

The outer plate of each clutch pack is a belleville spring (dished) which takes up all clutch pack clearance and adds a slight pre-load. When turning a sharp corner under normal conditions, the differential action is essentially the same as that of a conventional differential.

CAUTION: When working on a car with a Positive Traction Differential, never raise one rear wheel and run the engine with the transmission in gear. The driving force to the wheel on the floor may cause the car to move.

6-10 LUBRICATION OF POSITIVE TRACTION DIFFERENTIAL

The lubricant level should be checked every 1000 miles. Maintain level between the bottom of the filler plug opening and 1/4 inch below the opening by adding Special Positive Traction lubricant available through the Buick Parts Department under Part No. 531536. Never use lubricant other than this special lubricant, even for adding, or a severe clutch chatter may result when turning corners.

Positive Traction Differentials can be easily identified either by a stainless steel plate around the filler plug or by an X in a circle stamped on the bottom edge of the carrier housing flange. See Figure 6-41. However, if the wrong lubricant is accidentally added, it will be necessary to completely remove all lubricant, flush with light engine oil, and then fill with the special lubricant. Capacity of the rear axle housing is 4-1/2 pints.

Figure 6-41—Identification of Positive Traction Differential Axle

6-11 POSITIVE TRACTION DIFFERENTIAL SERVICE PROCEDURES

All rear axle service procedures are the same in the Positive Traction rear axle as in a conventional rear axle, except for servicing the internal parts of the differential assembly. All rear axle parts outside of the differential such as the ring gear, differential side bearings, and axle shafts are the same in either rear axle assembly.

a. Disassembly of Differential

1. If ring gear or differential case is to be replaced, remove ring gear from case. Otherwise ring gear need not be removed.

2. If a differential bearing is to be replaced, pull bearing outer race from case using Remover J-6552 as shown in Figure 6-14.

3. Clamp case assembly in a brass jawed vise by ring gear or by case flange.

4. Mark flange half and cover half of case with a center punch to provide alignment when assembling. If cross shafts are to be reused, see that they have a paint daub on one end of each shaft matching a similar paint daub on the case to assure assembly in proper location. See Figure 6-42.

5. Loosen 8 bolts holding cover half to flange half. Remove assembly from vise, place on bench with bolt heads up and remove bolts.

6. Lift cover half of case from flange half. Remove cover half cross shaft, pinions, side gear, side gear ring, clutch plates and discs. Keep with cover so they can be reinstalled in their original positions.

7. Remove corresponding parts from flange half of case and keep with flange half.

b. Cleaning and Inspection of Parts

1. Make certain that all differential parts are absolutely clean and dry.

2. Inspect cross shafts, pinions and side gears. Replace any parts which are excessively scored, pitted or worn.

3. Inspect side gear rings and differential case halves for scoring. Replace damaged or excessively worn parts. Both halves of case must be replaced if one half is damaged or worn.

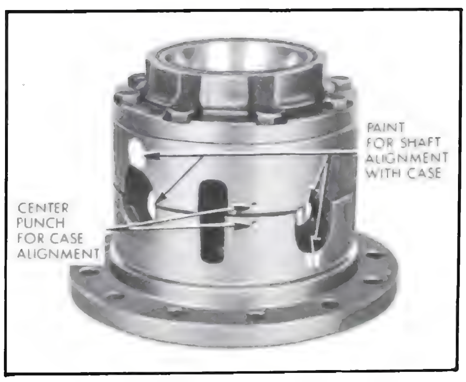


Figure 6-42—Alignment Marks

4. Inspect clutch discs and plates for worn, cracked or distorted condition. If any of these defects exist, new clutch packs must be installed.

c. Assembly of Differential

1. If ring gear was removed, install ring gear on case flange using three Studs J-6251 as shown in Figure 6-33.

2. If a differential bearing outer race was removed, drive new race into case using Replacer J-9742 as shown in Figure 6-32.

3. Place flange half of differential case on bench with opening up.

4. Oil clutch plates and discs thoroughly with Special Positive Traction Lubricant and install clutch packs. If inspection showed plates and discs to be in good condition, install original side gear ring and clutch pack on each side gear according to Figure 6-40. If any plates or discs were defective, install two new clutch packs.

5. Oil remaining parts with Special Lubricant just before installing. With clutch packs in place on both side gears, next install proper side gear and clutch pack in flange half of differential.

6. Install pinion gear and cross shafts as shown in Figure 6-44. Be certain bevelled sides of shafts match ramps in case. See Figure 6-43.

7. Install other side gear and clutch pack. Align clutch plate lugs with slots in differential case.

Figure 6-43—Matching Cross Shafts and Case Ramps

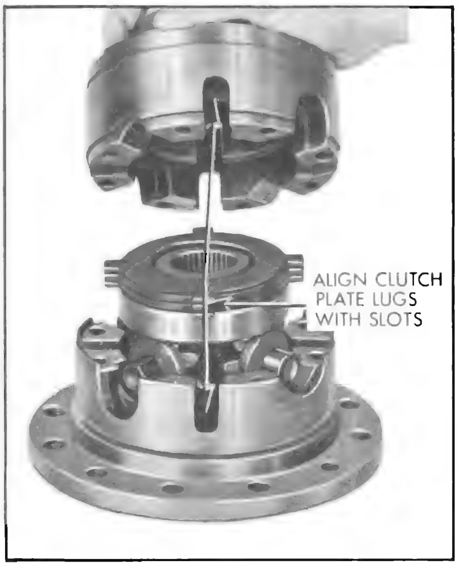


Figure 6-44—Installing Differential Parts

8. Check location of alignment marks on both halves of case and on cross shafts. Place cover half of case over clutch pack, engaging slots with clutch plate lugs. Make certain that paint daubs on shaft ends match daubs on case.

9. Install eight cover to flange half bolts and tighten evenly and alternately to 40 ft. lbs. torque. See Figure 6-45.

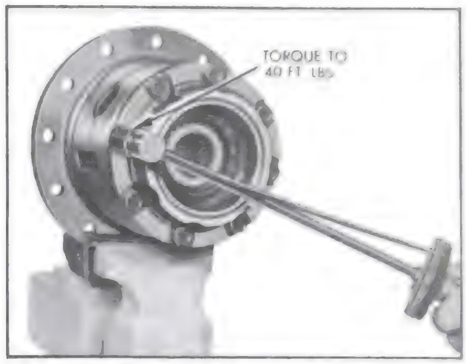


Figure 6-45—Torquing Differential Bolts

d. Simple Procedure for Testing a Positive Traction Differential

If there is a doubt that a Buick is equipped with a Positive Traction Differential, or to determine if this option is performing satisfactorily, a simple test can be performed.

Place a roller-equipped floor jack far outboard under the rear axle housing to slightly raise one wheel. This wheel should touch the floor merely to the extent that it can be turned by hand. With one person guiding the jack, another can attempt to slowly drive the car forward. If the car is equipped with a proper functioning Positive Traction Differential the car will move forward since the slipping wheel has just enough ground contact friction to engage the clutch pack.

SECTION 6-D

PROPELLER SHAFT

CONTENTS OF SECTION 6-D

6-12 DESCRIPTION OF PROPELLER SHAFT—4400-4600-4800

The propeller shaft assembly consists of a front propeller shaft, a rear propeller shaft, a standard universal joint at each end, and a double constant velocity type universal joint in the center. See Figure 6-46. A center support bearing attaches the rear end of the front propeller shaft to the frame tunnel. A splined front yoke on the front end of the rear propeller shaft extends into a splined coupling in the rear end of the front propeller shaft. This slip spline permits the slight lengthening and shortening of the propeller shaft required by the up and down movement of the rear axle assembly. See Figure 6-47.

The constant velocity universal joint is composed of two single joints connected with a special link yoke. A center ball and socket between the joints maintains the relative position of the two units. See Figure 6-47. This center ball causes each of the two joints to operate through exactly one half of the complete angle between the front and rear propeller shafts. Because the two joint angles are the same, even though the usual universal joint fluctuation is present within the unit, the acceleration of the front joint is always neutralized by the deceleration of the rear joint, or vice versa. The end result is, the front and rear propeller shafts always turn at a constant velocity.

The center support bearing consists of a sealed bearing, the inner race of which is held against a shoulder at the rear end of the front propeller shaft by a lock nut. The center bearing

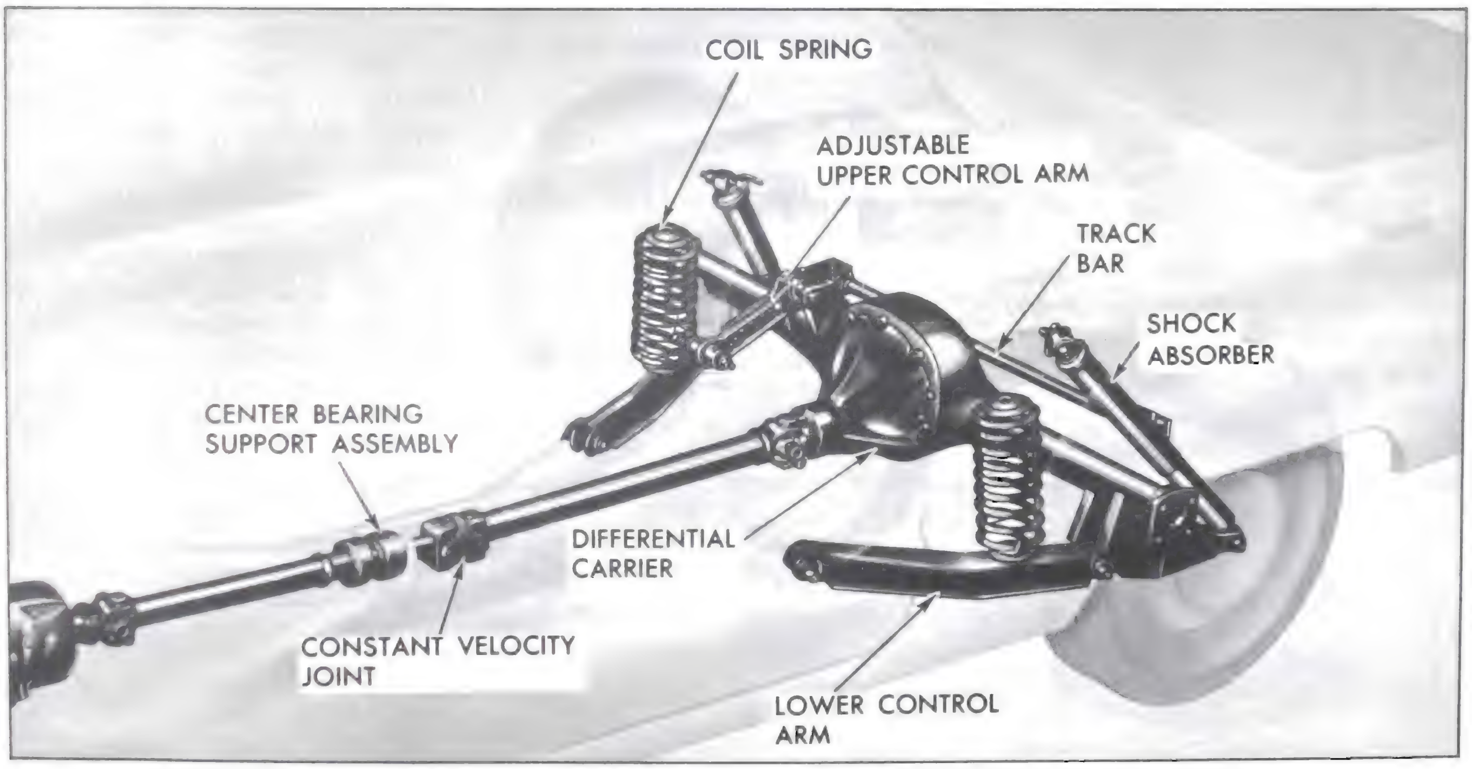


Figure. 6-46—Propeller Shaft and Rear Axle Assemblies—4400-4600-4800 Series

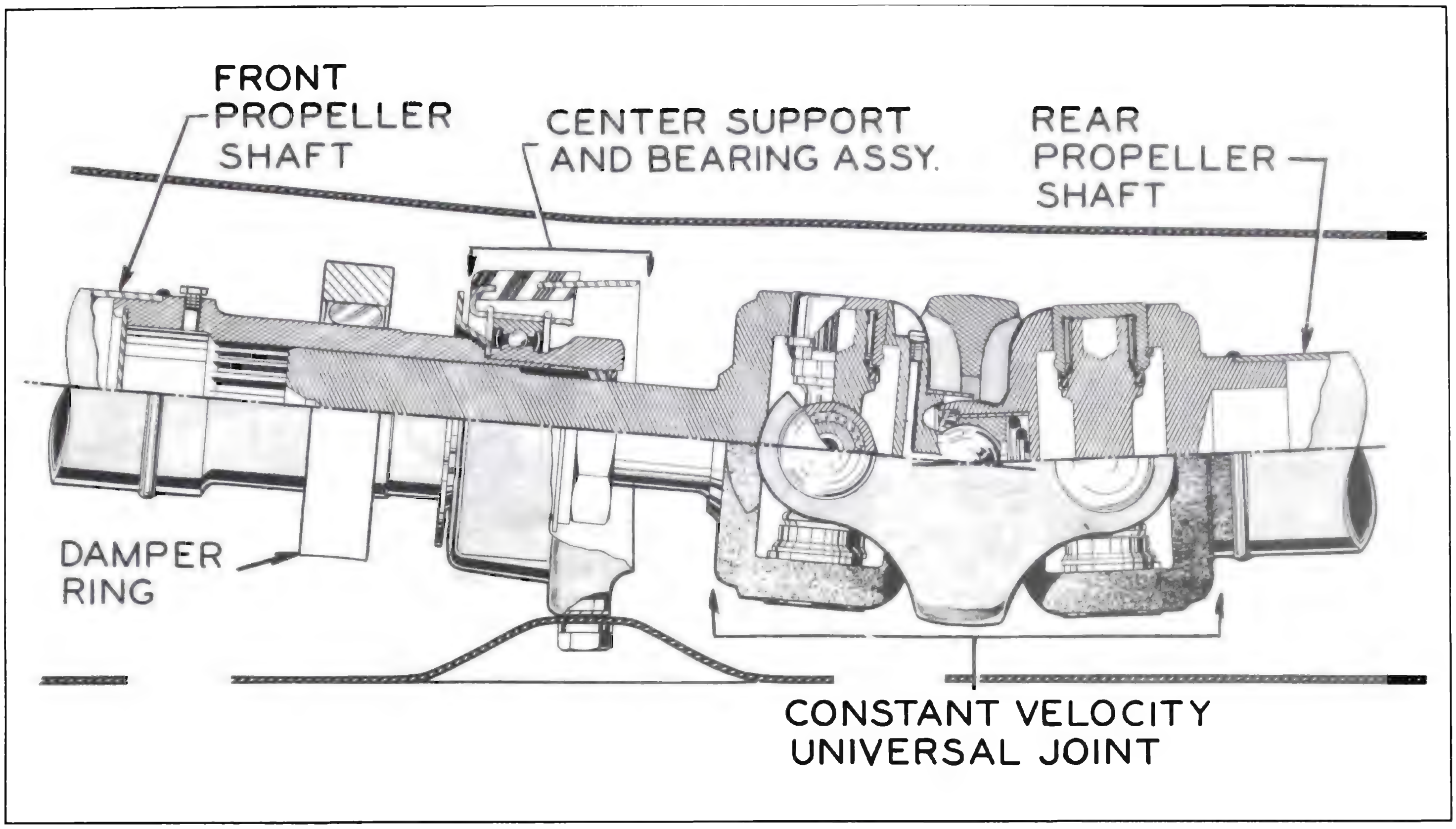


Figure 6-47—Center Support, Bearing, and Constant Velocity Joint

outer race sets in a metal retainer which has a rubber support cushion bonded to it. The rubber cushion in turn is bonded to a support bracket which is bolted to the frame tunnel. The locknut which retains the center bearing in place also prevents the slip joint from separating. The seal which retains the lubricant in the slip spline is located inside the locknut. See Figure 6-47.

The propeller shaft assembly requires very little periodic service. The center support bearing is lubricated for life and requires no additional lubrication. The universal joints are all lubricated for life and cannot be lubricated while in the car. If a joint becomes worn or noisy, a service kit must be installed which consists of a spider complete with bearing assemblies and snap rings.

Front and rear propeller shafts will not be available separately, but only as a complete propeller shaft assembly; this is because the complete assembly must be given a careful rotating balance and this type of balancing equipment is not available in the field.

If any part of the propeller shaft requires repair, it is necessary to remove the complete propeller shaft assembly from the car. The assembly must be handled very carefully to avoid jamming or bending any of the parts.

If the car is to be undercoated, care must be taken to keep the propeller shaft completely free of undercoating material. Undercoating or any other material would upset the balance and might cause a serious vibration.

The center ball stud and seat should be lubricated every 6,000 miles with Multi-Purpose Grease EP No. 1 Grade. Refer to paragraph 1-3.

The slip spline should also be lubricated with Multi-Purpose Grease EP No. 1 Grade every 12,000 miles, or after disconnecting the slip joint for any reason. To lubricate the spline, remove the plug and install a grease fitting. When grease appears at the slip joint nut, remove the fitting and reinstall the plug. The plug must be in place as lubricant would be thrown out through the fitting by centrifugal force at high speeds. Refer to paragraph 1-4.

6-13 DESCRIPTION OF PROPELLER SHAFT—4700

The propeller shaft used on 4700 Series utilizes a front universal joint and two constant velocity joints, one at the center of the shaft and the other at the rear. All components other than the rear constant velocity joints are similar in appearance and function to the 44, 46, and 4800 propeller shaft. See Figure 6-49.

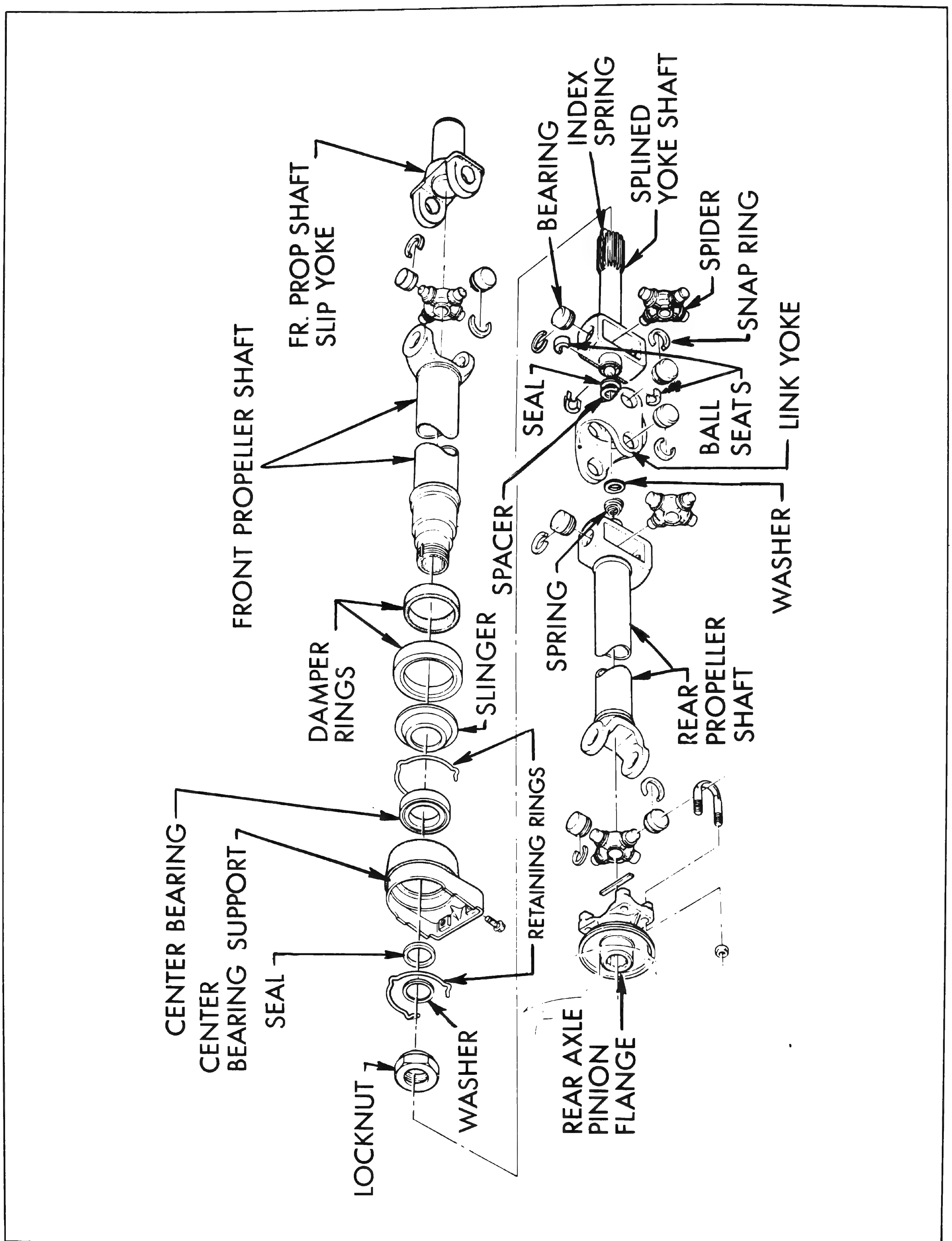


Figure 6-48—Exploded View—Propeller Shaft—4400-4600-4800 Series

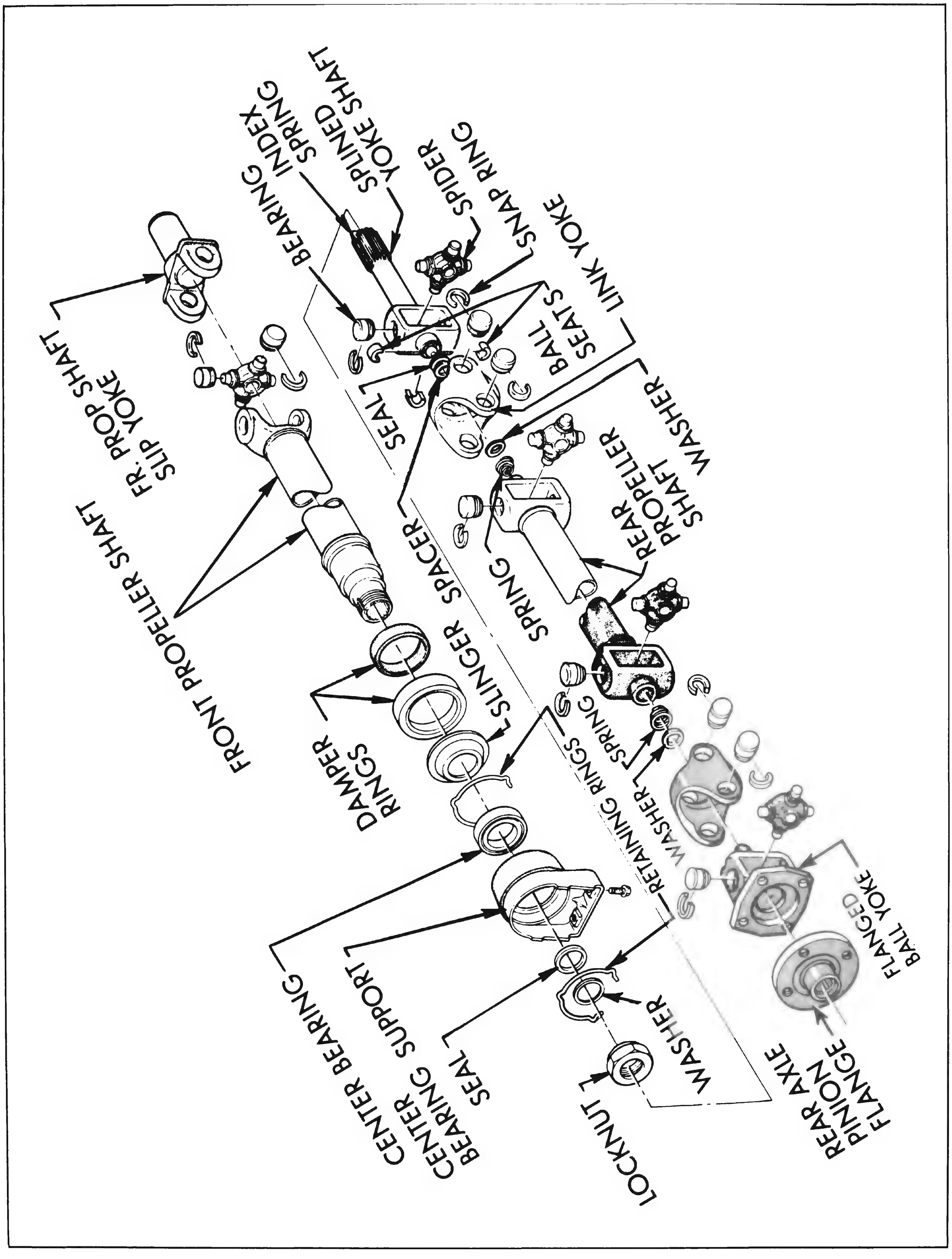


Figure 6-49—Exploded View—Propeller Shaft—4700 Series

The center and rear constant velocity joint ball stud seats should be lubricated every 6,000 miles with Multi-Purpose Grease EP No. 1 Grade. The center slip spline should also be lubricated every 12,000 miles with Multi-Purpose Grease EP No. 1 Grade.

Removal, installation and overhaul procedures are similar to 44, 46, 4800 propeller shafts with the exception of the additional rear constant velocity joint. This assembly is disassembled and reassembled in the same manner as the center constant velocity joint.

6-14 PROPELLER SHAFT TROUBLE DIAGNOSIS

COMPLAINT	POSSIBLE CAUSE	REMEDY
Shudder on acceleration, low speed.	Loose or missing bolts at center bearing support to frame tunnel.	Tighten bolts.
	Improperly adjusted rear joint angle.	Check and adjust using Kent-Moore alignment gauge.
	Incorrectly set front joint angle.	Shim under transmission support mount to decrease front joint angle.
	Incorrect plan view joint angles.	Use Kent-Moore alignment gauge cable and weighted strings from engine pulleys and propeller shaft to align shaft in plan view.
	Improper yoke phasing.	Check for correct yoke phasing and correct if necessary. See Figure 6-68 and 6-69.
Roughness or vibration, any speed.	Cut center bearing support rubber.	Replace.
	Improper yoke phasing.	Correct as above.
	Bent shaft.	Replace.
	Dented shaft.	Replace - check to see if sufficient clearance exists between rear frame tunnel and propeller shaft if car is raised on a frame hoist. Grind out frame for sufficient clearance if necessary.
	Improperly aligned support.	Align or check for proper installation of mountings.
	Tight universal joints.	Impact yokes with hammer to free up. Replace joint if unable to free up or if joint feels rough when rotated by hand.
	Worn universal joints.	Replace.
	U-joint retainer bent against bearing cup.	Replace.
	Undercoating on shaft.	Clean up shaft.

6-14 PROPELLER SHAFT TROUBLE DIAGNOSIS (Cont'd)

COMPLAINT	POSSIBLE CAUSE	REMEDY
Roughness or vibration, any speed. (con't.)	Incorrect U-bolt torque.	Check and correct - (15-18 ft. lbs.)
	Burrs or gouges on companion flange snap ring location surfaces.	Attempt to clean up flange. Replace companion flange if necessary.
	Incorrect rear joint angle (usually too large an angle).	Check and adjust using Kent-Moore alignment gauge.
	Tire unbalance.	Balance wheel and tire assembly or replace from known good car.
	Shaft or companion flange unbalance combination.	1. Check for missing balance weights. 2. Remove and reassemble shaft to companion flange 180° from initial location. 3. Remove and replace companion flange on transmission output shaft or rear axle pinion 180° from initial location. 4. Rebalance.
Roughness on heavy acceleration (short duration).	CV joint ball seats worn.	Replace with ball seat repair kit.
	Seat spring set or broken.	Replace with ball seat repair kit.
Roughness usually at low speeds, light load, 15-35 MPH.	Improperly adjusted joint angles.	Check and adjust rear joint angle, decrease front angle by shimming transmission support.
Whine or whistle.	Center support bearing.	Place car on hoist with rear wheels free to rotate and diagnose for source of noise. Replace center support bearing if found to be noisy.
Squeak.	Lack of lubricant or worn CV joint centering ball.	1. Lube. 2. Replace with ball socket kit if lube does not correct.
Knock or click.	Joint hitting frame tunnel.	Shim up or replace center bearing mount.
	Worn CV joint centering ball.	Replace with splined yoke or ball seat replacement kit.
	Loose upper or lower control arm bushing bolts.	Tighten bolts.

6-14 PROPELLER SHAFT TROUBLE DIAGNOSIS (Cont'd)

COMPLAINT	POSSIBLE CAUSE	REMEDY
Knock or click. (con't.)	Broken or cut center bearing support rubber.	Replace center bearing support.
	Stones - gravel in frame tunnel.	Remove stones and gravel.
Scraping noise.	Parking brake cable interference in frame tunnel.	Correctly route cable.
	Slinger on companion flange rubbing on rear axle carrier.	Straighten out slinger to remove interference.
Boom period 30 - 40 MPH carrying heavyloads or hauling trailer.	Excessive rear joint angle.	Reduce angle.

6-15 REMOVAL OF PROPELLER SHAFT

Whenever service is required, the propeller shaft must be removed from the car as a complete assembly. During handling out of the car, the assembly must be supported in a straight line as nearly as possible to avoid jamming or bending any of the parts.

1. Remove two center bearing support to frame tunnel bolts.

2. At rear pinion flange, remove U-bolt clamps from rear universal joint. (on 4700, remove four rear CV joint to pinion flange bolts.) Mark both flange and shaft to assemble in same position. CAUTION: If rear universal joint bearings are not retained on the spider by a connecting strap, use tape or wire to secure bearings.

3. Support rear end of propeller shaft to avoid damage to constant velocity universal joint and slide complete assembly rearward until front yoke slips from transmission shaft splines.

4. Protect the oil seal surface on the front slip yoke by taping or wiring a cloth over the complete front universal joint.

5. Slide complete propeller shaft assembly rearward through frame tunnel. Do not bend constant velocity joint to its extreme angle at any time.

6-16 DISASSEMBLY OF PROPELLER SHAFT ASSEMBLY

For ease in handling, and to help prevent damage to the constant velocity universal joint, the front and rear propeller shafts should be separated at the slip joint before any service operations are attempted. CAUTION: Never clamp propeller shaft tubing in a vise as the tube is easily dented. Always clamp on one of the yokes. Be careful not to damage the front propeller shaft slip yoke sealing surface. Any nicks can damage the bushing or cut the seal.

a. Disassembly of Slip Joint

1. Loosen locknut until free of threads and slide locknut and seal against the constant velocity joint.

2. Slide the rear propeller shaft from the front.

b. Removal of Center Bearing

1. Mount propeller shaft assembly in a vise by the yoke to keep it from turning while using the puller.

2. Place the smaller O.D. end of adapter J-2241-8 (Differential side carrier bearing puller adapter, 1955 and previous) into the splines of the propeller shaft. Position Differential side bearing puller J-2241-2 as shown in Figure 6-50. Pull the center support and bearing assembly from the

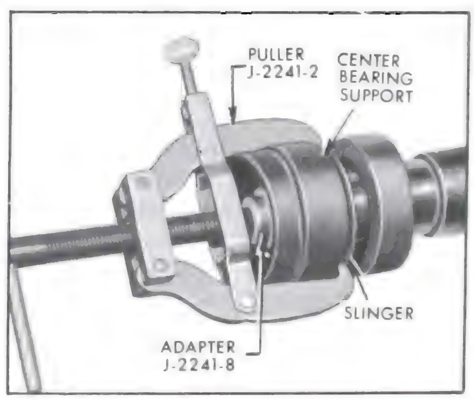


Figure 6-50 Removing Center Support and Bearing

propeller shaft. Leave the slinger (shield) in position on the shaft.

3. Remove the retainer rings from the bearing assembly, and remove the center bearing with the assistance of Remover J-7273-22 and Handle J-7013-1 (Flight Pitch Tools). See Figure 6-51.

c. Disassembly of Constant Velocity Universal Joint

All yokes must be marked before disassembly for reassembly in their original positions to maintain proper balance. For ease of disassembly remove the bearings from the link yoke first. See Figure 6-52. NOTE: On 4700, the following procedure applies to either center or rear constant velocity joints.

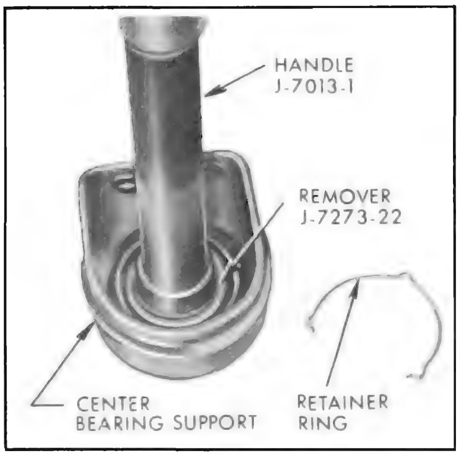


Figure 6-51—Removing Center Bearing from Support

1. Remove snap rings from the bearings. The snap rings are on the inside of the link yoke and can be removed with the assistance of Tool J-9522-1. See Figure 6-53.

2. Set up J-6180-01 Power Ram and J-6207 Hydraulic Pump in preparation for removing the propeller shaft bearings. With this use Axle Bearing and Retainer Replacer J-8853 as a base plate. Attach Adapter J-9522-2 onto the ram screw. See Figure 6-54.

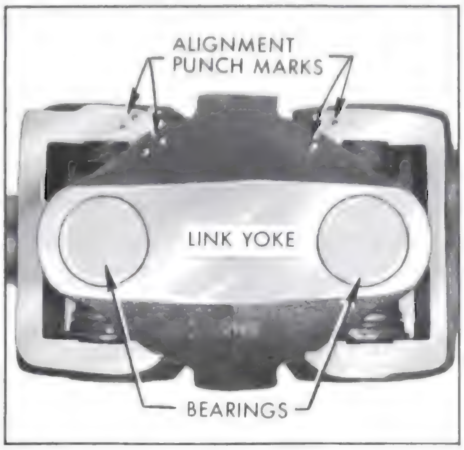


Figure 6-52—Link Yoke Showing Alignment Punch Marks

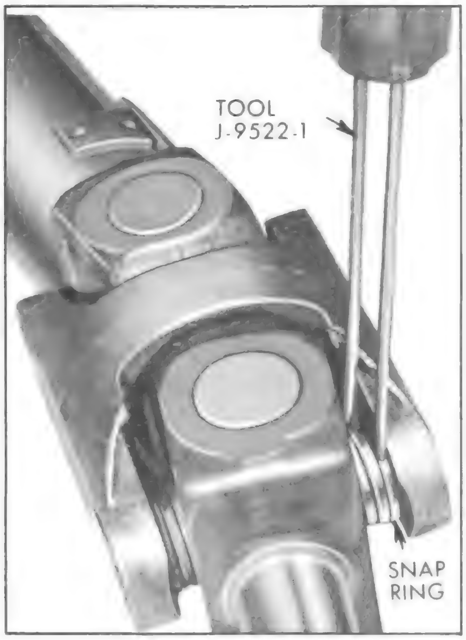


Figure 6-53—Removing Snap Rings from Propeller Shaft

3. Position propeller shaft constant velocity joint into the fixture as set up in Step 2 with the link yoke bearing over the hole in J-8853 Replacer Plate. Install Spider Press J-9522-3 on spider. See Figure 6-54. The notches in the spider press are offset so that this press can be positioned on the spider without interference from the link yoke casting.

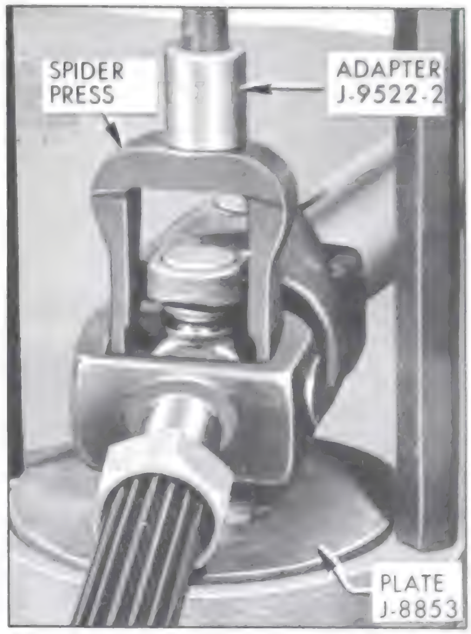


Figure 6-54—Pressing Out Bearing

With tools in position, actuate the pump and force the spider against the lower bearing, pushing the bearing as far out of the yoke and through the hole in Tool J-8853 as possible.

4. Release the pump and remove the propeller shaft. Install Spacer J-9522-5 over the spider journal at the space provided with the bearing forced partially through the link yoke. See Figure 6-55. Reposition propeller shaft in fixture as before and force with the added assistance of the Spacer.

5. Release the pump and the propeller shaft. Install Guide J-9522-8 through the bearing hole

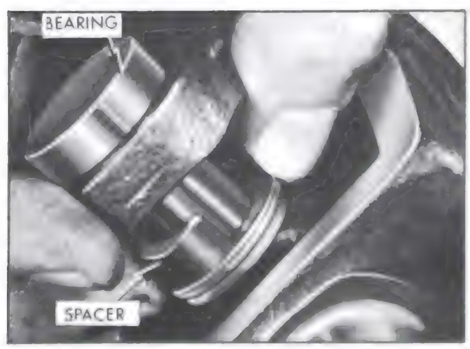


Figure 6-55—Installing Spacer

Figure 6-56—Installing Guide

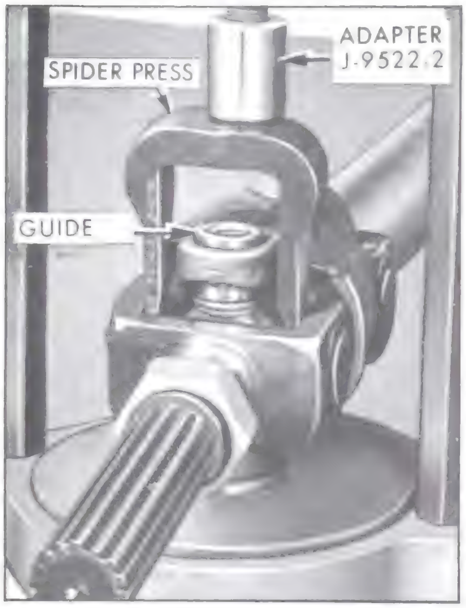


Figure 6-57—Removing Bearing with Guide and Spacer in Place

in the link yoke and over the journal end of the spider. See Figure 6-56. This guide assures alignment of the spider while removing the opposite bearing.

6. Install Spacer J-9522-5 adjacent to the bearing as in Step 4 and remove the bearing. See Figure 6-57.

7. Repeat Steps 3, 4, 5 and 6 to remove other bearings until the propeller shaft is disassembled to a point desired or until the spider can be slipped out of the link yoke.

d. Disassembly of Ball Stud Seat

1. Position the propeller shaft yoke in a vise so that the ball stud seat is accessible for removal.

2. With a screwdriver pry out the seal, remove seal washer, ball seats, seat washer, and ball seat spring.

e. Disassembly of the Front and Rear Universal Joints

CAUTION: Do not damage front propeller shaft slip yoke sealing surface. Any nicks can damage bushing or cut seal.

1. Remove snap rings from the bearings. The snap rings are on the inside of the yoke and can be removed with the aid of Tool J-9522-1. See Figure 6-53.

2. Set up J-6180-01 Power Ram and J-6207 Hydraulic Pump in preparation for removing the propeller shaft bearings. With this use Axle Bearing and Retainer Replacer J-8853 as a base plate. Attach Adapter J-9522-2 onto the ram screw. See Figure 6-58.

3. Position the propeller shaft universal joint into the fixture as set up in Step 2 with a bearing over the hole in Replacer J-8853.

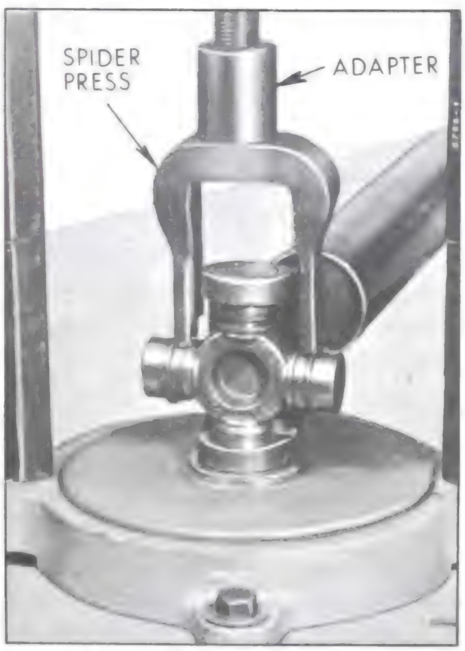


Figure 6-58—Pressing Out U-Joint Bearing

Install Spider Press J-9522-3 on spider. See Figure 6-58.

With tools in position actuate the pump and force the spider against the lower bearing, pushing the bearing as far out of the universal joint and through the hole in Tool J-8853 as possible.

4. Release the pump and remove the propeller shaft. Install Spacer J-9522-5 over the spider journal at the space provided with bearing forced partially through the yoke. See Figure 6-59. Reposition the propeller shaft in the fixture as before and force the bearing completely out of the yoke with the added assistance of the Spacer.

5. Release pump and propeller shaft. Install Guide J-9522-8 through the bearing hole in the yoke and over the journal end of the spider. See Figure 6-60. This

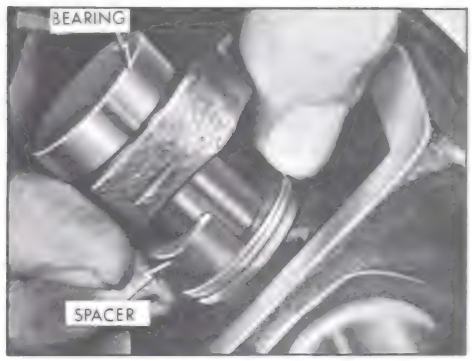


Figure 6-59—Installing Spacer

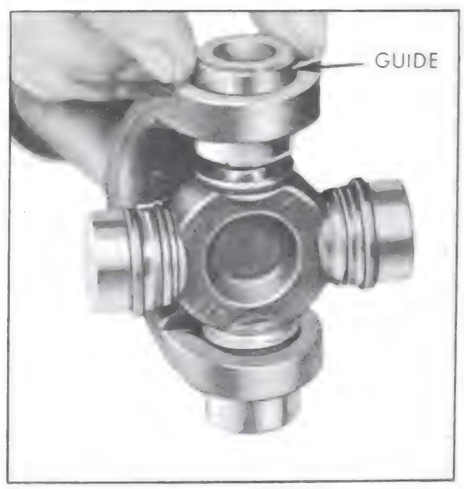


Figure 6-60—Installing Guide on U-Joint

guide assures alignment of the spider while removing the opposite bearing.

6. Install Spacer J-9522-5 adjacent to the bearing as in Step 4 and remove the bearing. See Figure 6-61.

7. Repeat Steps 3, 4, 5 and 6 to remove other bearings until the propeller shaft is disassembled to a point desired.

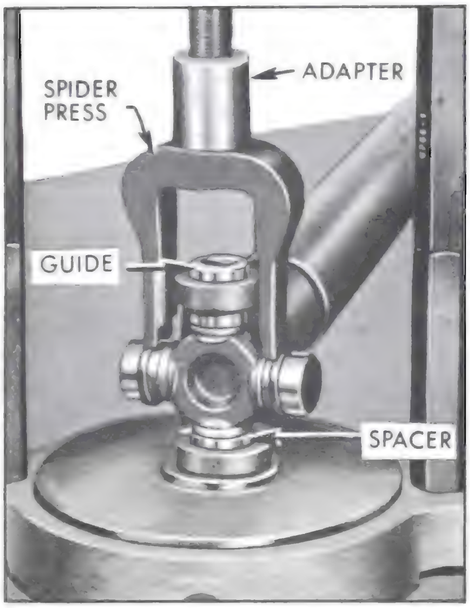


Figure 6-61—Removing Bearing with Guide and Spacer in Place

6-17 ASSEMBLY OF PROPELLER SHAFT

a. Assembly of Front and Rear Universal Joints

When inspection indicates any worn or damaged universal joint parts, always install a complete universal joint repair kit. Repair kits are listed in the Buick Parts Book under Gr. 5.442 and include a spider, four bearings, and four snap rings.

1. Position the new spider inside the yoke; it may face either direction. Make certain that the spider dust shields are not damaged upon installation.

2. Make certain that the bearings have a full set of rollers, are packed with lubricant, and that the seals are in position. Multi-purpose Universal Joint bearing grease #2 grade should be added to bearings if they are dry, although new bearings are normally pre-lubricated as received from the source.

Place the assembly in position with Power Ram J-6180 and Pump J-6207 as shown in Figure 6-62. Position the bearing straight over the hole in the yoke. Carefully pull up the spider so that the spider journal enters the loose bearing. With the pump force the bearing into the yoke continuing to hold the spider up in this bearing. Failure to do this could cause the bearing needles to become dislodged if the journal is engaged incorrectly.

When the bearing is correctly positioned in the yoke, turn the assembly over. Again place the bearing over the hole in the yoke. Carefully slide the spider partially out of the previously seated bearing and start it carefully into the bearing being installed. This is to prevent the needles from the bearing from burring the edge of the spider journal if forced over this journal other than straight. Even slight burring of the journal can cause premature failure.

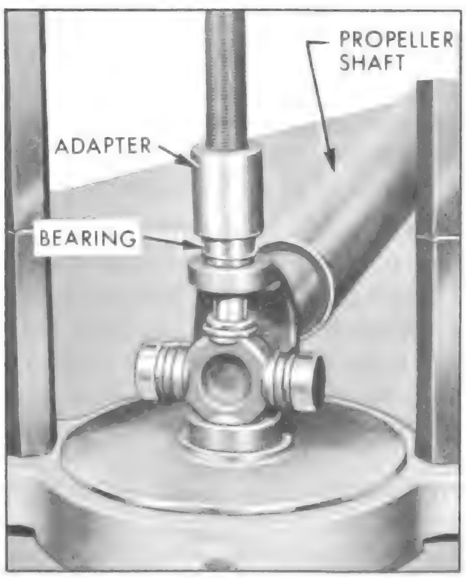


Figure 6-62—Pressing Bearing Into Place

While pressing bearings into position, move the spider back and forth to make certain that the spider journals engage the bearings squarely to avoid damage and binding. If binding exists, remove the bearings and spider and examine for dislodged rollers or damaged journals.

3. Observing the previous precautions, install the balance of the bearings necessary to complete the assembly, and install snap rings.

4. Strike the yoke with a hammer to fully seat the snap rings against the yoke. Turn the spider to make certain that it is free. See Figure 6-63.

b. Assembly of the Ball Stud Seat

Examine the ball stud and ball stud seats for scores or wear. Worn seats can be replaced by using a replacement kit, Gr. 5.442. Since the ball stud is an integral part of the splined yoke, any scoring of this part requires the replacement of this splined yoke. This assembly is also available in kit form, Gr. 5.442.

1. Clean out the seat cavity thoroughly, then pack with Multi-purpose grease EP No. 1 grade.

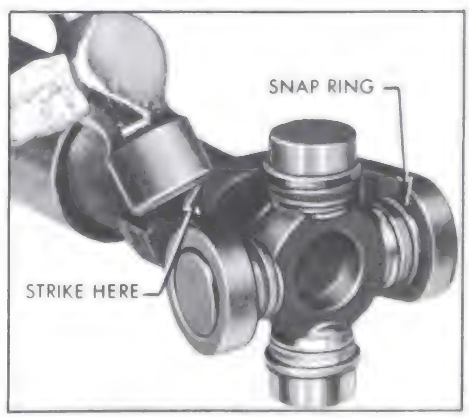


Figure 6-63—Seating U-Joint Snap Rings

2. Install spring, small end first. Install seat washer, ball stud seats, and seal washer. See Figure 6-64.

Apply Permatex on the outer diameter of the seal to insure adequate sealing and install seal with its lip towards the seat using Tool J-9732. See Figure 6-65.

3. Stake the seal lightly and evenly in four places. Be careful not to over stake so as to damage or distort the seal.

4. Pack the cavity around the ball stud with Multi-purpose grease, EP No. 1 grade.

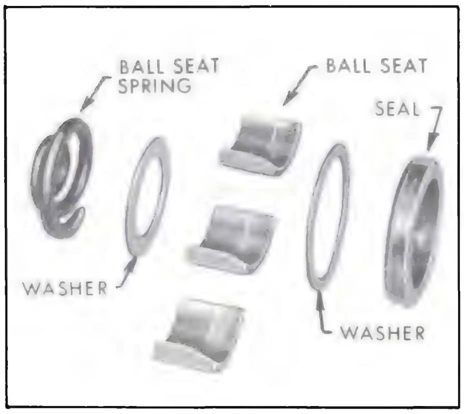


Figure 6-64—Ball Seat Assembly

Figure 6-65—Installing Ball Seat Seal

c. Assembly of Constant Velocity Universal Joints

All yokes must be carefully assembled using the marks made before disassembly to assure balance maintainance of the complete propeller shaft assembly.

When inspection indicates any worn or damaged CV Universal Joint parts, always install a complete repair kit. Repair kits are listed in the Buick Parts Book under Gr. 5.442 and include a spider, 4 bearings and 4 snap rings.

1. Make certain that the bearings have a full set of rollers, are packed with lubricant, and that the seals are in position. Multi-Purpose universal joint bearing grease, #2 grade should be added to bearings if they are dry, although new bearings are normally pre-lubricated as received from the source.

2. For ease of assembly use the following sequence:

a. Connect the link yoke to the rear propeller shaft as outlined in Step 3 below.

b. Insert a new spider without bearings into the splined shaft yoke.

c. Position the ball stud into the ball stud seat while working the spider journals into the holes in the link yoke. Make certain that the spider dust shields are not damaged upon installation.

3. Place the assembly in position with Power Ram J-6180 and Pump J-6207 as shown in Figure 6-66. Position the bearing straight over the hole in the yoke. Carefully pull up the spider so that the spider journal enters the loose bearing. With the pump, force the bearing into the yoke, continuing to hold the spider up in this bearing. Failure to do this could cause the bearing needles to become dislodged if engaged incorrectly.

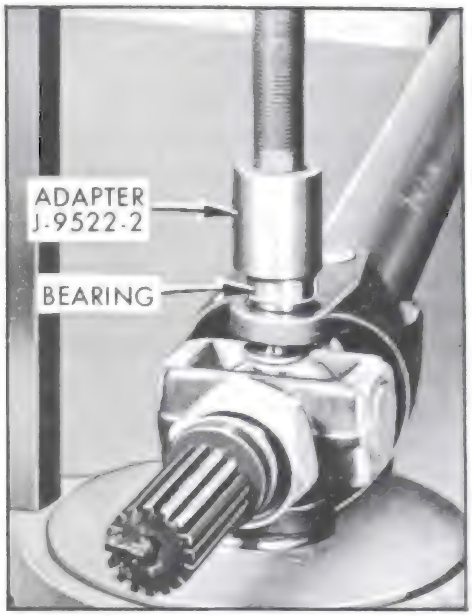


Figure 6-66—Pressing Bearing Into Position

When the bearing is correctly positioned in the yoke, turn the assembly over. Again place the bearing over the hole in the yoke. Carefully slide the spider partially out of the previously seated bearing and start it carefully into the bearing being installed. This is to prevent the needles from the bearing from burring the edge of the spider journal if forced over this journal other than straight. Even slight burring of the journal can cause premature failure.

While pressing bearings into position, move the spider back and forth to make certain that the spider journals engage the bearings squarely to avoid damage and binding. If binding exists, remove the bearings and spider and examine for dislodged rollers or damaged journals.

4. Install the balance of the bearings necessary to complete the assembly and install snap rings.

5. Strike the yoke with a hammer to fully seat the snap rings against the yoke. Turn the spider to make certain that it is free. See Figure 6-67.

NOTE: If a new splined yoke assembly was used, the car should

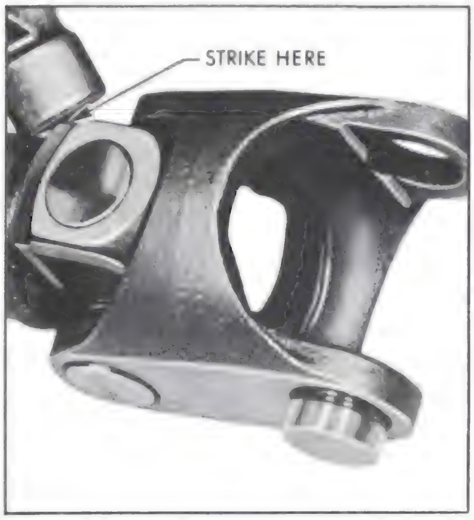


Figure 6-67—Seating Snap Rings

be carefully roadtested for possible vibration caused by out-of-balanced propeller shaft. If propeller shaft vibration is encountered see the procedure for balancing this assembly in paragraph 6-21.

d. Installation of Center Bearing

1. Install new bearing into center bearing support with the aid of Installer J-7013-24 and handle J-7013-1 (Flight Pitch Tools). See Figure 6-68.

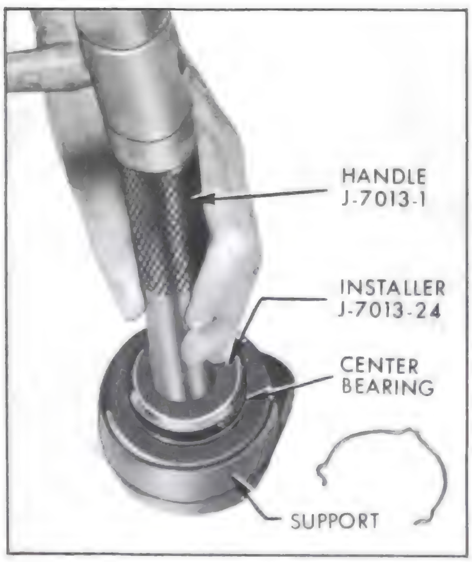


Figure 6-68—Installing Center Bearing Into Support

2. Install retainer ring to secure bearing.

3. Making certain that the shield is in place on the propeller shaft, install the center bearing support assembly onto the propeller shaft with Installer J-21007.

e. Assembly of Slip Joint

1. Make certain that the locknut, split washer and seal are in place on the smooth part of the spline shaft. Make certain that the index spring wire is in place in the splines. Also make certain that the large lock washer is in place on the rear end of the front propeller shaft.

2. Align the index spring with the missing internal spline in the rear end of the front propeller shaft, and slide the slip joint together. See Figure 6-69 for proper phasing of the propeller shaft.

3. Install the locknut and tighten securely to 65 ft. lbs. using locknut Wrench J-21009.

6-18 INSTALLATION OF PROPELLER SHAFT

The propeller shaft must be supported carefully during handling to avoid jamming or bending any of the parts.

1. Protect the oil seal diameter on the front slip yoke by taping or wiring a cloth over the complete front universal joint.

2. Slide complete propeller shaft assembly forward through frame tunnel.

3. Remove protecting cover from front universal joint. Fill space between lips of transmission seal with wheel bearing grease and apply a thin coat of the same grease to the seal surface of the front universal joint.

4. Slide front universal joint yoke forward over splines of transmission shaft.

5. Compress two loose bearings of rear universal joint toward each other using a 4 inch C-clamp. See Figure 6-70. This allows the bearings to seat in the pinion flange without the snap rings gouging the locating surfaces of the pinion flange while entering.

6. Install U-bolt clamps and nuts. Draw nuts up evenly and torque to 13 ft. lbs. using a 1/2 inch extension such as J-9113. (On 4700, install four pinion flange bolts and torque evenly to 75 ft. lbs.). See Figure 6-71. CAUTION: Overtightening U-bolt nuts

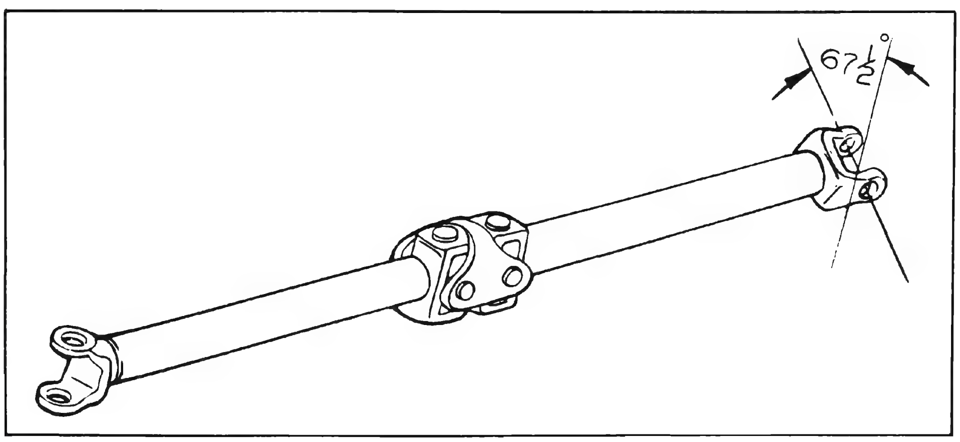


Figure 6-69—Propeller Shaft Phasing—4400-4600-4800 Series

distorts the bearings, causing a binding on the spider which can cause drive line shudder and also reduce the life of the bearings and spider.

7. Install two bolts in center bearing support. Torque to 18-25 ft. lbs.

8. Make certain propeller shaft slip spline and center ball stud seat are fully lubricated with Multi-Purpose Grease EP No. 1 Grade. See paragraphs 1-3 and 1-4 for lubricating procedure.

6-19 ADJUSTMENT OF REAR UNIVERSAL JOINT ANGLE—4400-4600-4800

When torque is transmitted through any ordinary universal joint, the driven yoke fluctuates slightly in speed. In other words, although the driving yoke rotates at a constant speed, the driven yoke speeds-up and slows-down twice per revolution. This fluctuation of the driven yoke is in direct proportion to the angle through which the universal joint is operating; the greater the angle, the greater the fluctuation.

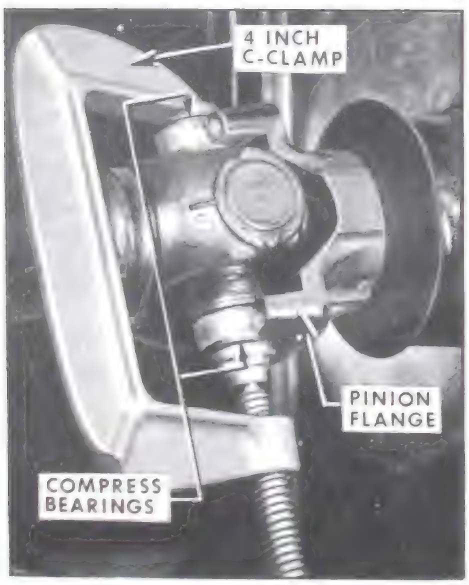


Figure 6-70—Using C-Clamp to Install a Universal Joint

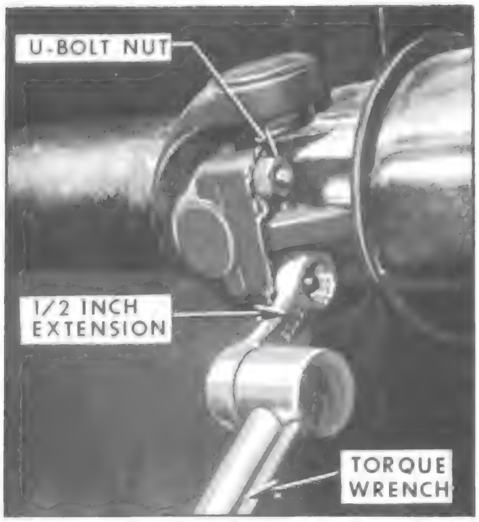


Figure 6-71—Using Extension to Torque U-Bolt Nuts

Whenever two universal joints are used, this fluctuation effect can be eliminated by staggering the joints so that the two driving yokes are 90° apart providing the two joints are transmitting torque through the same angle. Therefore, when two universal joints are used, the angles through which they operate must be very nearly the same. This allows the alternate acceleration and deceleration of one joint to be offset by the alternate deceleration and acceleration of the second joint. When the two joints do not run at approximately the same angle, operation is rough and an objectionable vibration is produced.

In addition, universal joints are designed to operate safely and efficiently within certain angles. If the designed angle is exceeded, the joint may be broken or otherwise damaged.

The front universal joint angle is actually the angle between the engine-transmission centerline and the front propeller shaft. This angle is determined by the design of the body assembly. Since this angle is not liable to change with use, there is normally no need to change this angle.

The center constant velocity universal joint, just as the name implies, transmits at a constant velocity regardless of the angle through which it is operating. Therefore, no means is provided or needed for adjusting the constant velocity joint.

However, the rear universal joint angle can vary and must be adjusted. It is adjusted by rotating the rear axle housing; this is accomplished by lengthening or shortening the upper control arm by means of a "Vernier" arrangement of adjusting holes. See Figure 6-72.

If drive line shudder, roughness, vibration, or rumble is experienced, it may be due to incorrect rear universal joint angle and this angle should be checked. Also if there is a severe rear end collision, or if the axle housing or any control arms are replaced, the rear universal joint angle should be checked and corrected if necessary.

A simple method has been developed for measuring rear universal joint angle using a spring-loaded steel cable stretched between the front of the chassis and the rear axle carrier. When the rear universal joint

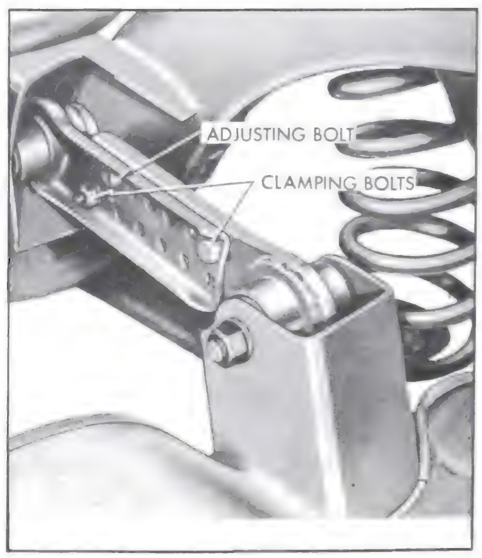


Figure 6-72—Upper Control Arm

angle is adjusted correctly, this steel cable will clear the underside of the pinion flange by a definite amount. Therefore, if this single direct measurement is within specified limits, the rear universal joint angle is correct; if this measurement is out of limits, the joint angle is not correct. See Figure 6-73.

Rear universal joint angle is checked using Alignment Set J-8973. The Alignment Height Tubes J-8973-19 in this set are designed to raise the rear of the car slightly above normal trim height. Use of these tubes makes sure that the rear universal joint angle will be checked at a predetermined trim height.

The front end of the cable is equipped with two attaching brackets so that the cable may be used on all series 1964 Buicks. The rear end of the cable has stops attached at various points to allow the cable to be placed in tension on all wheelbase Buicks.

a. Checking Rear Universal Joint Angle

Check rear universal joint angle using the following procedure:

1. Raise car, preferably on a drive-on hoist. Install Alignment Height Tubes J-8973-19 by raising the rear of the body slightly with one hand while inserting the upper end of the tube over the head of the axle bumper rear bolt, with the lower end resting on the axle housing. See Figure 6-73. If the body does not come down firmly on the tubes, add weight in the trunk until the tubes are held tightly.

2. Remove two differential carrier mounting nuts, one on each side of the lowest nut. Install two special flat washers over studs, then install Rear Bracket J-8973-16 with bent edge toward front and slot to the right, using nuts just removed. See Figure 6-73.

3. Take cable assembly and hook Front Attaching Bracket J-8973-15 over center of front frame cross member. Pull cable tight and position cable all-the-way in slot of rear bracket so one of the stops is to the rear of the bracket.

4. Position Engine Height Plate J-8973-14 vertically with wide end centered against front flange of engine pan. Pull cable down and place in lower notch of plate. See Figure 6-73.

5. Measure perpendicular distance from machined surface immediately in front of slinger on rear pinion flange to top of cable. This distance is given for 44-46-4800 models in Figure 6-73.

b. Adjusting Rear Universal Joint Angle

If the distance measured in Step 5 above was not correct, the pinion nose must be moved up or down as required. This is done by changing the length of the upper control arm.

Adjust rear universal joint angle using the following procedure:

1. Place a jack under pinion nose. Because of the geometry of the rear suspension, the pinion nose will tend to move downward when released and must be held upward.

2. Loosen nuts and bolts at two slotted holes and remove middle adjustment bolt. See Figure 6-74.

3. Using jack, raise or lower pinion nose as required to get correct measurement from pinion flange to top of cable.

4. Install adjustment bolt in holes which line-up and tighten nut.

5. Lower jack from under pinion nose and recheck measurement. If measurement is slightly off, a fine adjustment can be made by simply loosening all three upper arm nuts and bolts, moving the pinion nose in the desired direction, then retightening the nuts and bolts. This finer adjustment is possible because of some looseness of the adjustment bolt in its holes.

6. Torque upper arm nuts and bolts to 80-110 ft. lbs.

7. Remove all parts of the alignment set, being careful to avoid kinking cable in handling and storing.

8. Reinstall differential carrier nuts and torque to 50 ft. lbs.

6-20 ADJUSTMENT OF UNIVERSAL JOINT ANGLES—4700

Because of the constant velocity joints at the center and rear of the 4700 propeller shaft, the car is not sensitive to pinion angle adjustment. Therefore, no adjustment is necessary. However, if rear CV joint bottoms on underbody, or if propeller shaft is rubbing on the frame tunnel, adjustment must be made to provide sufficient clearance.

6-21 PROPELLER SHAFT BALANCING PROCEDURE

1. Place the car on a twin post hoist so that the rear of the car is supported on the rear axle housing and the rear wheels are free to rotate.

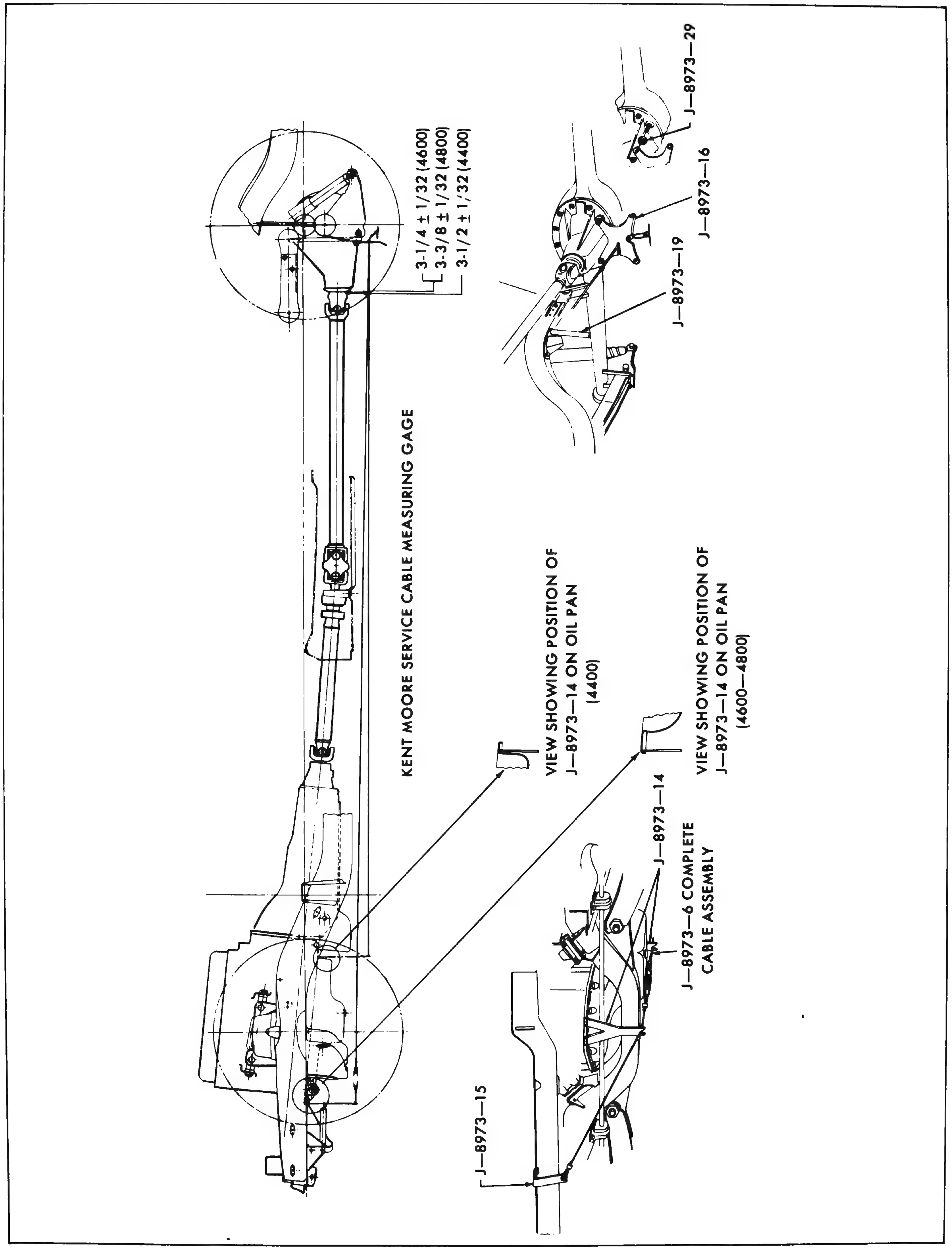


Figure 6-73—Checking Rear Universal Joint Angle—4400-4600-4800 Series

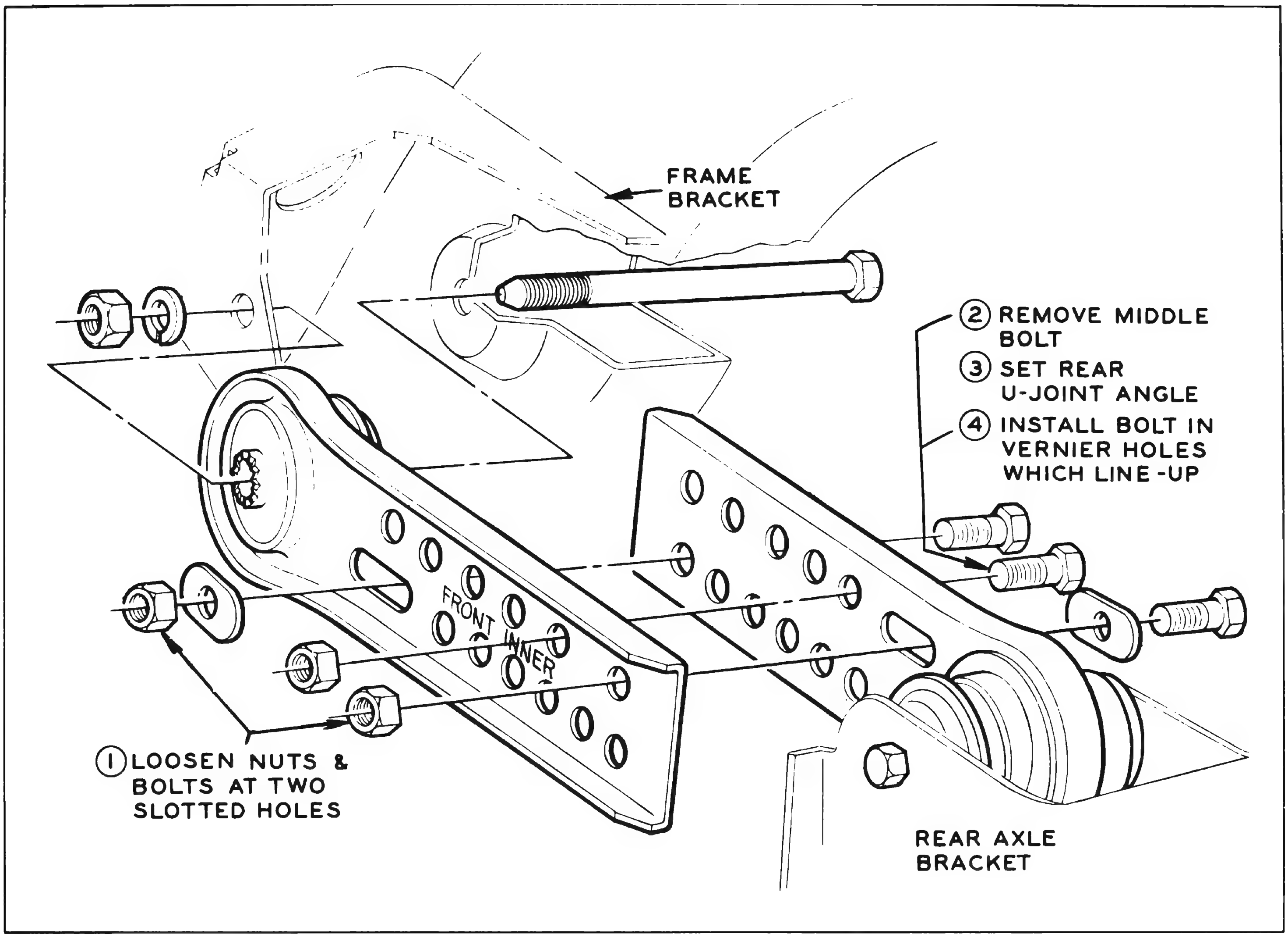


Figure 6-74—Adjusting Rear Universal Joint Angle

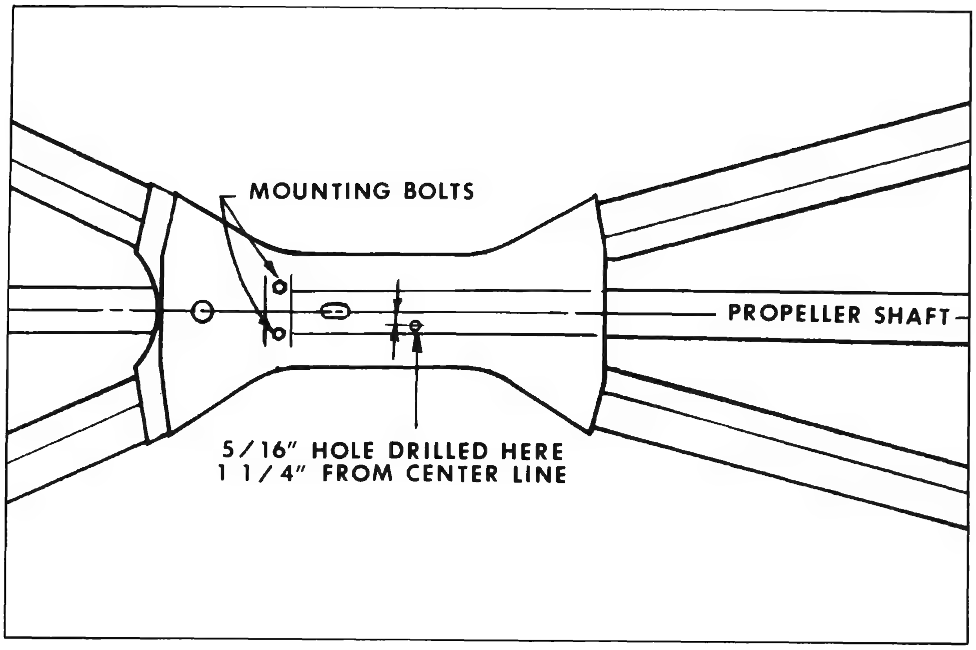


Figure 6-75—Locating Access Hole in Frame

2. Balancing at the center of the propeller shaft just rearward of the CV Joint is all that is normally required. It is often possible to locate the heavy side of the shaft by holding a crayon or colored pencil close to the shaft while the shaft is rotating (speedometer indicating 40-50 MPH.) and carefully bringing the crayon upwards until it just contacts this rotating shaft. If carefully done, the heavy side (point of maximum runout) only will be marked by the crayon. This normally gives a good indication of which side of the shaft is heavy for unbalance, and serves as a starting point for initial location of the hose clamps.

3. Install two (2) Wittek #28 hose clamps (Gr. 1.166, Part #1351813) on the rear propeller shaft and slide them forward until the clamps stop at the nearest balance weight welded to the tube. This involves working the clamps into the frame tunnel with the fingers.

4. To provide an access hole in the frame tunnel for inserting a screwdriver to tighten the hose clamps, drill a 5/16" hole located as follows: Measure from the rear of the frame tunnel forward to the first welded-on balance weight. Subtract 1/2" from this measurement; then using this distance, measure from the rear of the frame tunnel forward and mark this distance on the bottom outside frame tunnel. This locates the hole between the clamp screws so both can be reached. Offset the hole approximately 1-1/4" from the car centerline and drill the 5/16" hole. See Figure 6-75.

5. Place the two hose clamps side by side with the heads together and 180° from the crayon marking. See Figure 6-76. Tighten the clamps.

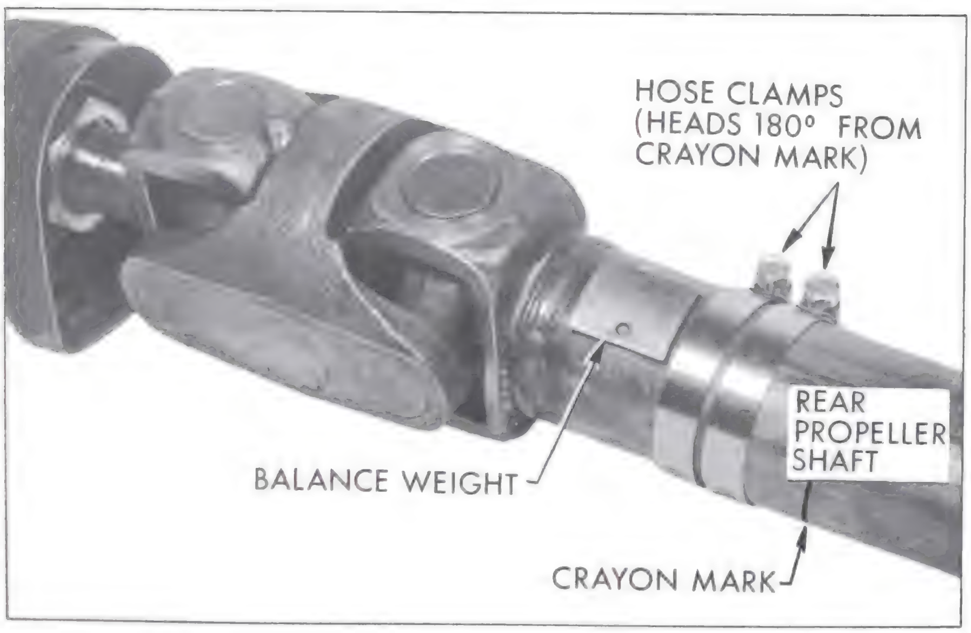


Figure 6-76—Hose Clamps in Place Opposite Crayon Mark

6. Run the car through the speed range to 65 - 70 MPH. If no unbalance is felt, nothing further need be done on the hoist. However, if unbalance still exists, rotate both clamps to the opposite side of the shaft and retighten. Run car again and notice if the unbalance feel is better or worse; if worse, return the clamps to the original position. Apparently the combined weight of the two hose clamp heads was excessive, so to reduce this excess rotate the clamp heads away from each other 45° (one each way from the original position). See Figure 6-77. Run car and note if unbalance has improved.

7. Continue to rotate the clamps apart in smaller angular increments until the car feel for unbalance is best.

CAUTION: Do not run car on hoist for extended periods due to danger of overheating the transmission or engine.

8. Roadtest the car again for final check of balance.

NOTE: Vibration felt in the car on the hoist may not show up in a roadtest which is after all the final determining factor.

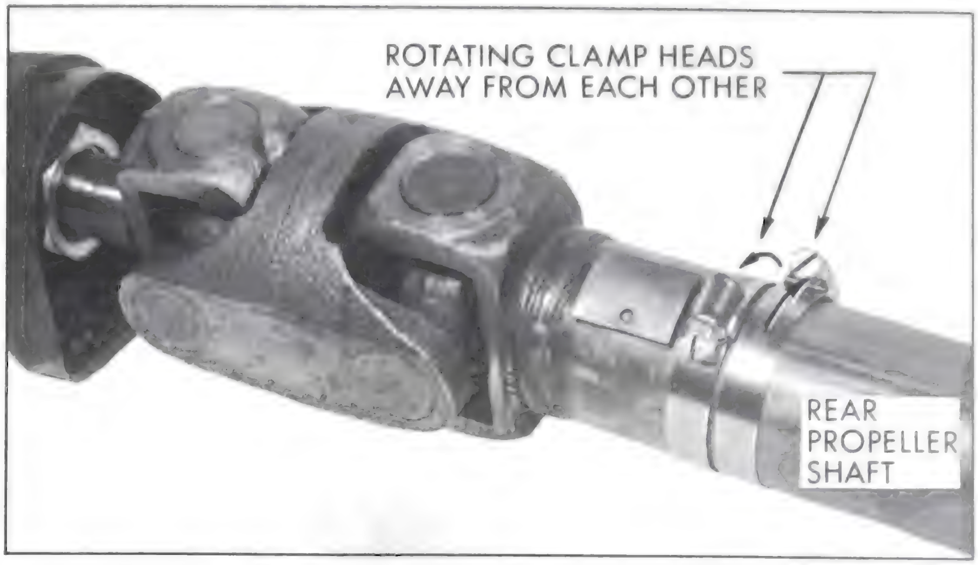


Figure 6-77—Rotating Hose Clamp Heads from Each Other

Figure 6-78—Propeller Shaft Tools

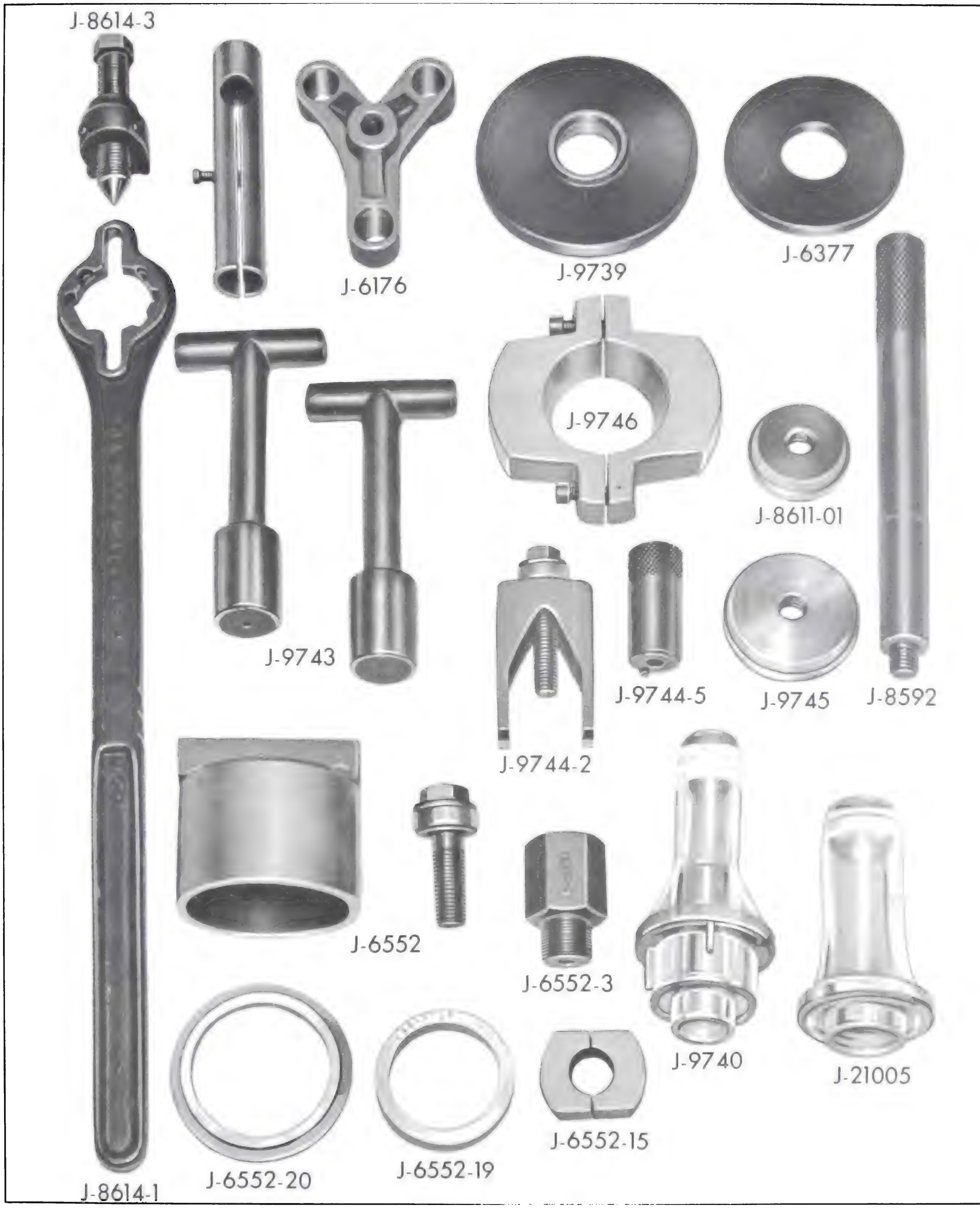


Figure 6-79—Rear Axle Tools

GROUP 7

CHASSIS SUSPENSION

SECTIONS IN GROUP 7

SECTION 7-A

SPECIFICATIONS AND DESCRIPTION OF CHASSIS SUSPENSION

CONTENTS OF SECTION 7-A

7-1 CHASSIS SUSPENSION SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque-Ft. Lbs.
Nut	Brake Reaction Rod to Lower Control Arm	1/2-13	80-100
Nut	Brake Reaction Rod to Frame	9/16-18	60-80
Nut	Track Bar	5/8-18	100-140
Nut	Rear Shock to Upper Bracket	1/2-13	35-45
Nut	Front Shock to Lower Bracket	7/16-14	35 Min.
Bolt	Front Shock to Lower Control Arm	3/8-16	15-25
Nut	Front Shock to Frame	3/8-24	5-10
Bolt	Stabilizer Bushing to Frame	3/8-16	25-35
Bolt	Idler Arm Support to Frame	3/8-16	40-50
Nut	Upper Control Arm Shaft to Frame	9/16-18	90-110
Bushing	Upper Control Arm	1 3/32-11	70 Min.
Nut	Upper Ball Joint to Knuckle	7/16-20	30-40
Nut	Lower Control Arm Bumper to Lower Control Arm	7/16-14	80-100
Nut	Front Lower Control Arm to Frame	3/4-10	80-120
Nut	Lower Ball Joint to Knuckle	9/16-18	60-75
Nut	Spindle - Bearing Adjustment (See Par. 7-10)	3/4-20	--
Bolt & Nut	Brake Assembly and Steering Arm to Knuckle, Front	7/16-20	40-50
Bolt & Nut	Brake Assembly and Steering Arm to Knuckle, Rear	1/2-20	65-75
Bolt	Brake Assembly through Anchor Pin to Knuckle	9/16-18	130-150
Nut	Wheel to Front Hub or Rear Axle Shaft	1/2-20	65-85
Nut	Rear Lower Control Arm to Frame	1/2-13	60-90
Nut	Stabilizer Link to Lower Control Arm	5/16-24	5-10
Nut	Rear Spring Clamp to Frame	1/2-13	15-20
Nut	Rear Spring Clamp to Rear Lower Control Arm	1/2-13	20-30
Bolt	Rear Axle Bumper to Frame	5/16-18	10-15

b. Wheels and Tires

Item	Series 4400	Series 4600	Series 4700	Series 4800
Wheel Type		Demountable Steel Disk	*Demountable Steel Disk	
Rim Type		Drop Center	*Drop Center	
Rim Size	15" x 6.00 L	15" x 6.00 L	15" x 5.50 K	15" x 6.00 L
Tire Type		Tubeless	*Tubeless	
Tire Size	7.10"-15"	7.60"-15"	7.10"-15"	8.00"-15"
Optional Tire Size	7.60"-15"	8.00"-15"	7.60"-15"	None
Tire Inflation Pressures		See Paragraph 1-2	*See Paragraph 1-2	
Wheel Attaching Studs and Nuts				
Rear Drums		1/2-20	*1/2-20	
Front Finned Aluminum Drums		1/2-20	*1/2-20	

*Same All Series

c. Shock Absorbers

Item	All Series
Shock Absorber	
Make and Type—Front	Delco, Double Direct-Acting
Make and Type—Rear	Delco, Double Direct-Acting

d. Springs

Spring Trim Dimensions	See Paragraph 7-13
Spring Type	Coil Front and Rear

e. Dimensional Specifications

NOTE: Dimensions and limits in these specifications apply to new parts only. Where limits are given, "T" means tight and "L" means loose.

Item	All Series
Caster, Camber, Toe-in, Effective K.P.I., and Steering Geometry	See Figure 7-34
Steering Knuckle Spindle	
Large End, Diameter	1.3743—1.7348
Small End, Diameter	.8430—.8435
Wheel Bearing Cone on Spindle	
Outer	.0004" L—.0014" L
Inner	.0005" L—.0015" L
Wheel Bearing Cup in Hub	
Outer	.0005" T—.0025" T
Inner	.0005" T—.0025" T
Wheel Bearing Adjustment	See Paragraph 7-10
Stabilizer Shaft	All Model 2 Dr. Coupes and Convertibles 27/32" Bar
	All Model 4 Dr. Except Estate Wagons 53/64" Bar
	Estate Wagons 29/32" Bar

7-2 DESCRIPTION OF WHEEL SUSPENSION

a. Front Wheel Suspension

The front wheel suspension is designed to allow each front wheel to rise and fall, due to change in road surface level, without appreciably affecting the opposite wheel.

Each wheel is independently connected to the frame front cross member by a steering knuckle, ball and socket assemblies, and upper and lower control arm assemblies. See Figure 7-1. The upper and lower arms are so placed and proportioned in length that they allow each knuckle, and wheel to move through a vertical arc only. The front wheels are held in proper relation to each other for steering by means of two tie rods which connect to steering arms on the steering knuckles and to an intermediate rod.

A coil type chassis spring is mounted between the frame front cross member and lower control arm assembly.

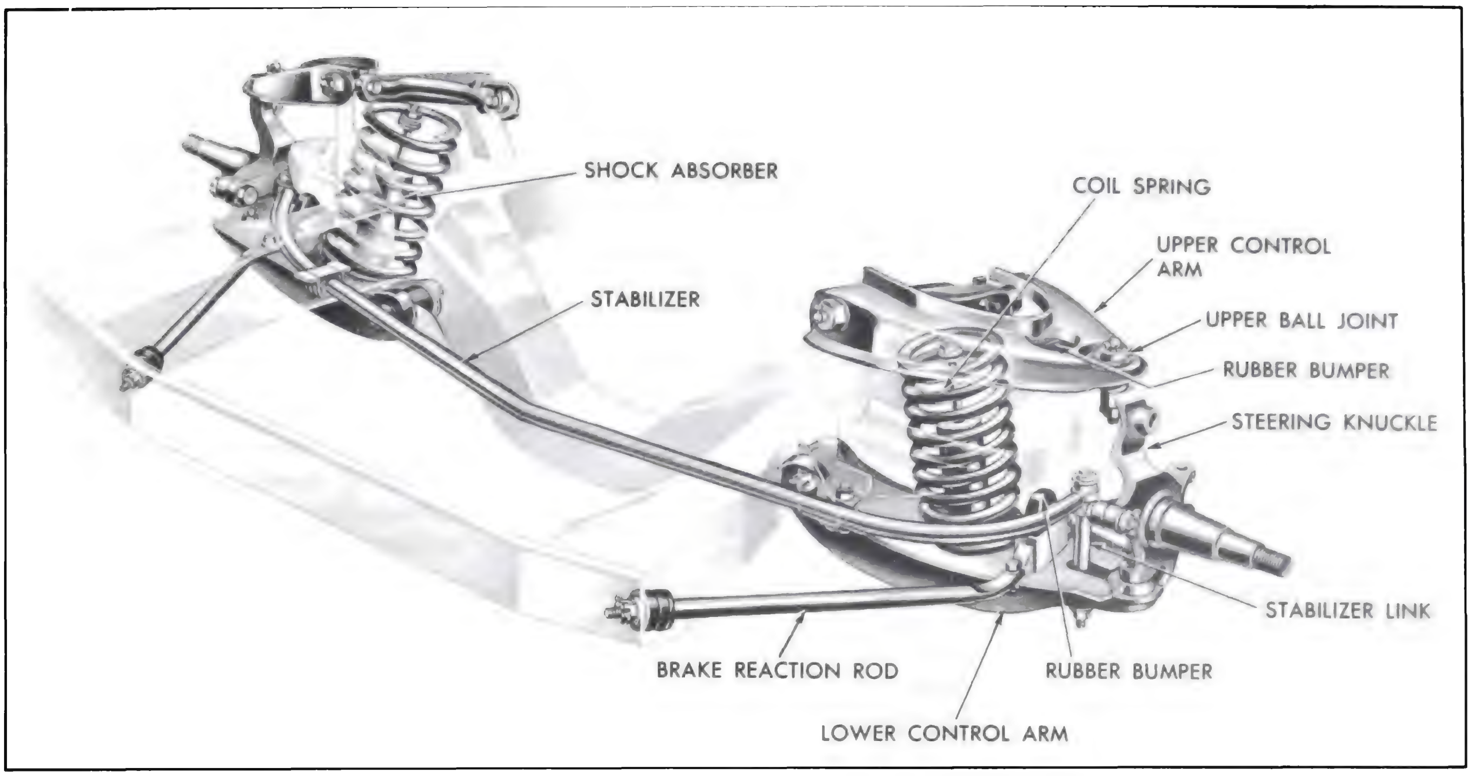


Figure 7-1—Front Suspension

A rubber bumper is mounted on the outer end of each lower control arm to limit travel of the arm during compression of chassis spring. A similar rubber bumper is mounted on the frame under each upper control arm to limit travel of arm during rebound of chassis spring.

Side roll of the front end of chassis is controlled by a spring steel stabilizer shaft. The shaft is mounted in rubber bushings supported in brackets attached to lower flange of each frame side rail. The ends of stabilizer shaft are connected to the front sides of lower control arm by links which have rubber grommets at both ends to provide flexibility at the connections and prevent rattle. See Figure 7-7.

The lower control arm assembly consists of two stamped steel plates welded together. The inner ends of the lower control arms are bolted to the frame front cross member through rubber bushings. The outer end of each arm is connected to the steering knuckle with a ball socket assembly pressed in the lower control arm and bolted to the steering knuckle. The ball socket can be removed in service with suitable tools. Position of the lower control arms is maintained by a brake reaction rod mounted between the lower control arm and frame. See Figure 7-1.

To resist fore and aft movement of the lower control arm in relationship to the frame, two solid steel brake reaction rods are positioned between the lower control arms and front of the frame side rails. The forward ends of the rods are rubber mounted to hold securely to the frame bracket with castellated nuts and cotter pins. The rearward end of the brake reaction rod attaches to the lower control arm with two 1/2"-13 bolts.

Special hardened flat washers are used under the bolts and nuts to aid in maintaining required torque. The brake reaction rod must be properly installed and secured prior to checking and adjusting caster and camber.

The upper control arms consists of a single stamped steel plate formed to provide maximum strength. Two replaceable hardened steel bushings are threaded into the inner end of each assembly. Rubber seals are installed on shafts to exclude dirt and water from the bearing surfaces. Lubrication fittings are provided at both bearing locations on upper arm inner shafts. As in the lower control arms, a ball joint is positioned through the outer end of each arm.

The steel forged steering knuckle accommodates tapered roller bearings in the front wheel hubs. The brake shoe anchor pin is rigidly bolted to the steering knuckle. It is not adjustable.

During brake application two forces act on the front suspension. When the brakes are applied, the torque is transmitted to the backing plate and knuckle assembly through the brake

shoes, which tends to rotate the backing plate and knuckle assembly forward. The weight of the car is thrown forward tending to move the front of the car downward. This downward motion is called "front-end dive". In order to minimize "front-end dive", the upper control arm shaft is mounted to the frame so that the front end of the shaft is higher than the rear end at an angle relative to that of the lower control arm shaft. Thus, when the braking force is applied, the tendency of the car's front end to dive rotates the backing plate and spindle assembly in a rearward direction, while the braking torque tends to rotate the backing plate and spindle assembly in a forward direction. Therefore, the braking torque creates an upward force nearly equal to the downward (diving) force. In this manner, "front-end dive" is held to a predetermined minimum. See Figure 7-1.

b. Rear Wheel Suspension

Rear wheels are not independently sprung since they are mounted on axle shafts incorporated in the rear axle assembly. The rear wheels are held in proper alignment with each other by the rigid construction of the rear axle housing and by a pair of lower control arms. With the use of an open-type drive line, driving and braking forces are taken by these control arms. The control arms are connected to the frame at their front ends, and to a bracket welded to the axle housing at the opposite ends. Both mounting joints are pivoted through rubber bushings.

To prevent the axle housing from rotating about the two lower control arms during braking and acceleration and to adjust rear universal joint angle, an adjustable, third control arm is mounted between the frame side rails and axle housing to a bracket on the upper right side of the housing. Adjustment is obtained through a series of vernier-spaced holes and two slotted holes in the two piece arm.

The angles at which the universal joints operate are extremely critical. Car roughness is greatly affected by universal joint angles, therefore, joint angles as specified must be adhered to and maintained as described in paragraph 6-19.

Two coil type chassis springs are mounted at an angle forward and to center of car between the lower control arm and the frame cross member at top of kickup. Ride control is provided by two identical double direct-acting shock absorbers angle-mounted between brackets attached to the axle housing and to frame cross member.

Brackets for attaching the track bar are located with the frame bracket on the left and the axle housing bracket on the right. The track bar is rubber mounted at each end.

To maintain relative position of the frame side rails and further prevent rear axle sway, a track bar is mounted between the track

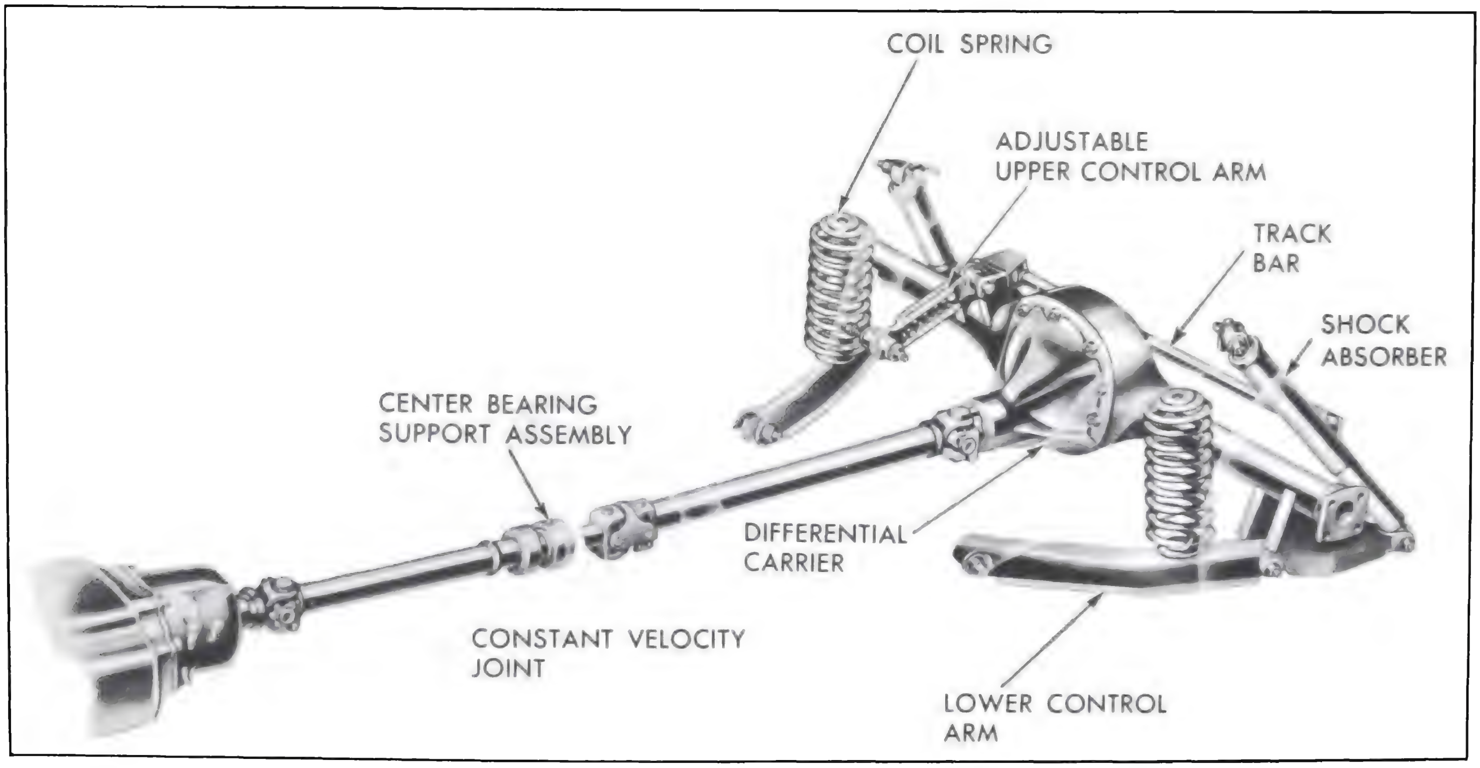


Figure 7-2—Rear Suspension

bar frame bracket on the left and frame side rail on the right. See Figure 7-2.

c. Wheels and Tires

Wheels are demountable steel disk type. The wheels have wide drop center type rims designed to give ample support for the tire sizes used as standard equipment. The rims have a tapered tire bead seat on the inboard side and a hump-type bead seat on the outboard side which cause tire beads to wedge tightly in place when tires are inflated.

CAUTION: When mounting a tire on this type of wheel, it is imperative to apply mounting soap around the beads for ease of mounting and to prevent damage to the beads.

Tires are tubeless low pressure balloon type. U.S. Royal, Firestone, Goodyear and Goodrich tires are used in production without optional selection of any specified make.

All tires used as standard factory equipment have been worked out with the tire manufacturer for stability. This does not imply that other makes and types of tires are not suitable for Buick cars, but owing to the large number of tire makes and designs it is impossible for ride and handling calibrations to be worked out for each one.

Standard production tire sizes are given in paragraph 7-1. Tires other than those used as standard equipment may cause a wander. Larger tires will reduce clearance at fenders and be difficult to mount in spare carriers. Tires with more plys may cause hard riding. Some types of tire and tube combinations are difficult to balance and may cause "tramp".

7-3 SHOCK ABSORBERS

a. Shock Absorber Type and Location

Both front and rear shock absorbers are Delco, double, direct-action, (telescoping) hydraulic type. All shocks are filled with a calibrated amount of fluid and sealed during production; therefore, no refilling or other service is possible other than replacement of deteriorated rubber bushings.

Each front shock absorber is vertically mounted inside the front spring. The upper stem is attached to the frame by means of grommets and grommet retainers held in place by a nut. The lower insulated bracket is bolted to the lower control arm.

Each rear shock absorber is mounted on an angle with the upper end "in" toward the center of the car. The upper end is attached to a frame bracket. The lower end is attached to a bracket welded to the rear axle housing.

The shock absorbers are basically the same for all models but vary as to calibration. Front shock absorbers are interchangeable in respect to right and left, as are the rear. However, front and rear are not interchangeable with each other.

b. Shock Absorber Construction and Operation

The shock absorber consists of two concentric tubes, a piston and rod, and valves for controlling hydraulic resistance. The rear shock absorber has an additional tube which acts as a stone shield.

The pressure (inner) tube provides a cylinder in which the piston and rod operate. The upper end is sealed by a piston rod seal, and the lower end is closed by the

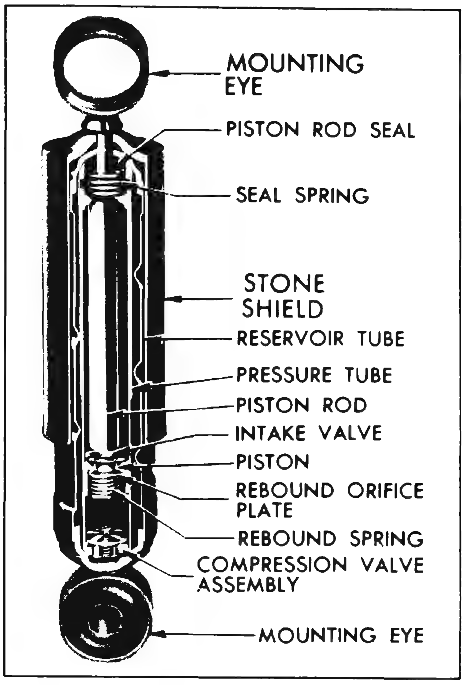


Figure 7-3—Typical Shock Absorber (Rear Shown)

compression valve assembly. This tube is completely filled with fluid at all times. The reservoir tube provides space for reserve fluid and for overflow from the pressure tube during operation.

The piston, piston rod and outer tube are attached to the car frame, while the pressure and reservoir tubes are attached as a unit to the chassis suspension through the lower mounting. As the wheel moves up and down with respect to the frame the chassis spring compresses or expands, and the shock absorber is telescoped or extended. This action forces the fluid to move between the pressure and reservoir tubes through small restricting orifices in the valves. The relative slowness of fluid movement imposes restraint on the telescoping or extension of the shock absorber, thus providing the required dampening effect on spring action.

(1) Compression Stroke Operation. When the chassis spring is being compressed the shock absorber is telescoped, causing the piston to move down in the pressure tube, forcing fluid through

holes in the piston. The pressure lifts the intake valve plate, allowing fluid in lower chamber to pass into the upper chamber. As the piston rod moves downward into the pressure tube it occupies space previously filled with fluid and this displaced fluid is forced out of the lower chamber into the reservoir through the restricting orifice in the compression valve. On fast or extreme movements when the fluid flow exceeds the capacity of the orifice, the spring loaded relief valve in the compression valve assembly is forced open to permit more rapid escape of fluid. The amount of compression control is governed entirely by the volume of fluid displaced by the piston rod, and the resistance to chassis spring travel is governed by the area of the orifice and the strength of the compression relief valve spring.

(2) Rebound Stroke Operation. When the chassis spring expands, or rebounds, the shock absorber is extended and its resistance is instantly effective. As the piston is pulled upward the intake valve plate seats and fluid in the upper chamber is forced through slots in the plate and holes in the piston to build up pressure against the rebound orifice plate. As the pressure increases, the rebound spring is compressed and the orifice plate leaves its seat to permit fluid to pass into the lower chamber. As the piston rod moves upward out of the pressure tube the space previously occupied by the rod is filled with fluid drawn into the lower chamber from the reservoir. A separate intake valve in the compression valve assembly opens to permit return of this fluid.

SECTION 7-B
TROUBLE DIAGNOSIS—CHASSIS SUSPENSION

CONTENTS OF SECTION 7-B

7-4 ABNORMAL TIRE WEAR

a. General Operating Conditions

Assuming that there is no misalignment condition to cause unnatural wear, the life of tires depends largely upon car operating conditions and driving habits.

Tires wear at a much faster rate in some localities than in others because of road and operating conditions. Some types of roads are much more abrasive than others. Tire wear is also dependent upon the number of hills and mountains which the car must go up and down, the severity of grades, the number of starts and stops, driving speeds, the amount of rain and snow, and prevailing temperatures. Tire wear increases rapidly with both speed and temperature. Tires used at low speeds or in cool climates will have longer life than tires used for high speed driving in hot climates.

Driving habits have a very important bearing on tire life. A careful driver may obtain much greater mileage from a set of tires than would be obtained by a severe or careless driver. Rapid acceleration and deceleration, severe application of brakes, taking turns at excessive speed, high speed driving, and striking curbs or other obstructions which lead to misalignment are driving habits which will shorten the life of any tire.

Maintenance of proper inflation pressure and periodic interchanging of tires to equalize wear are within the control of the driver. Underinflation raises the internal temperature of a tire greatly, due to the continual friction caused by the flexing of the side walls. Tire squealing on turns is an indication of underinflation or excessive speed on the turns. A combination of underinflation, high road temperatures, and high speed driving will quickly ruin the best tire made.

High speed on straight highways or expressways normally causes more rapid wear on the rear than on the front tires, although cupping of front tires can result if the tires are not periodically switched from wheel to wheel. Driving turns and curves at too high a rate of speed causes the front tires to wear much faster than the rear tires.

An inspection of the tires, together with information as to locality in which the car has been operated will usually indicate whether abnormal wear is due to the operating conditions described above, or to mechanical faults which should be corrected.

The various types of abnormal tire wear and their causes are described in the following subparagraphs.

b. Shoulder or Underinflation Tread Wear

When a tire is underinflated, the side walls and shoulders of the tread carry the load while the center of tread folds in or compresses due to the low internal air pressure. This action causes the shoulders to take all of the driving and braking load, resulting in much faster wear of shoulders than of the center of tread. See Figure 7-4, View A. For maximum results in handling, riding and tire life, tire inflation pressures should never be allowed to go below the specified minimum pressure (par. 1-2).

Continuous high speed driving on curves, right and left, may produce tread wear very similar to underinflation wear and might very easily be mistaken for such. Side thrust when rounding turns causes wear on the sides of tire tread. In making a turn to the left, especially at high speeds, the outside shoulder of the right tire and the inside shoulder of the left tire take the side thrust and naturally receive the most wear. The only possible correction is to advise slower speeds on curves. Do not increase tire inflation pressures beyond specified limits as this will cause center or overinflation wear (subpar. c, below).

c. Center or Overinflation Tread Wear

On a tire that is overinflated the center of the tread receives much more driving and braking strain than the sides or shoulders. The center of the tread therefore wears away much faster than the shoulders and, if tire is continuously overinflated, may be worn thin while the shoulders have plenty of tread material left. See Figure 7-4, View B.

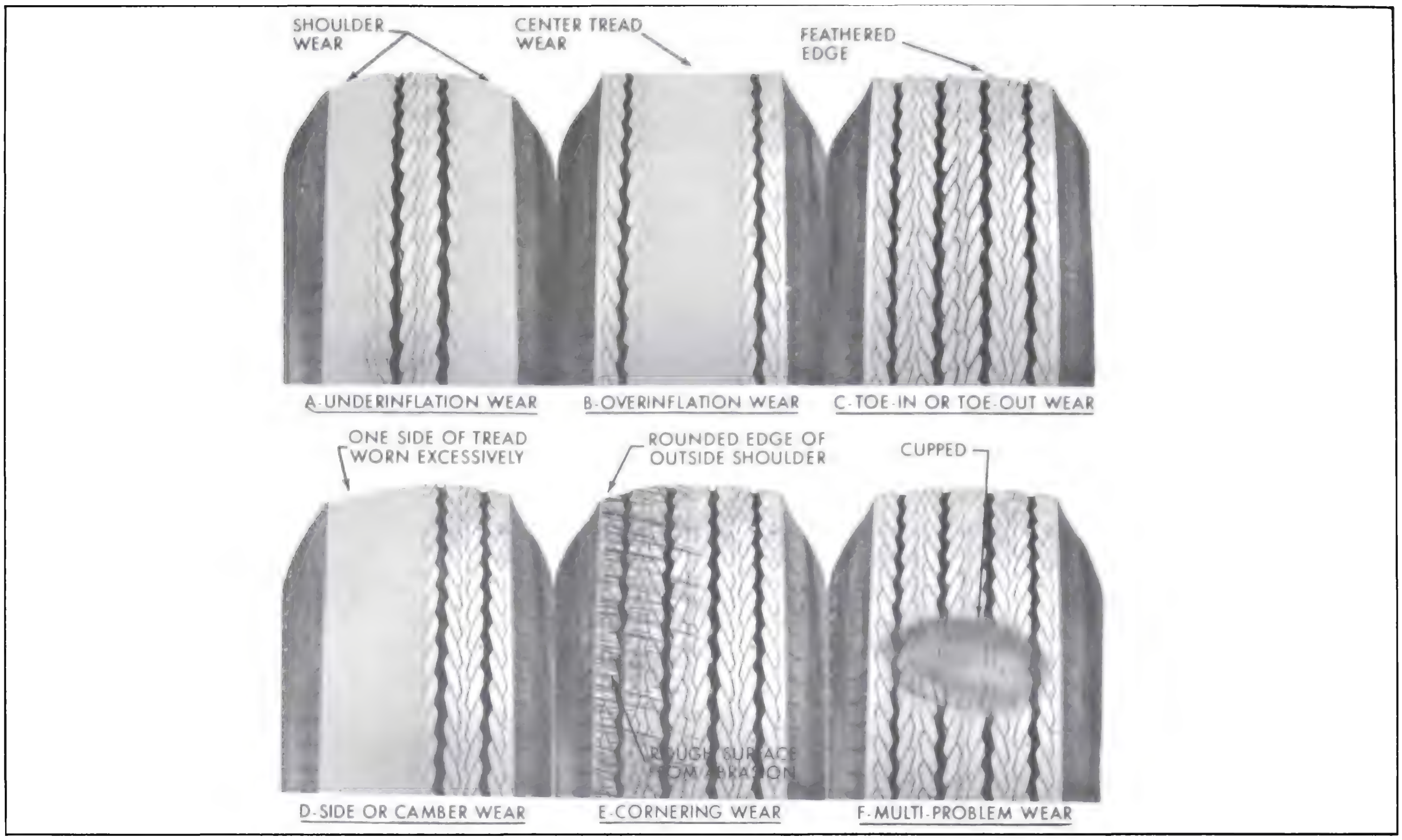


Figure 7-4—Abnormal Tire Tread Wear Patterns

When tire inflation pressures are maintained within the specified limits (par. 1-2) the tire will make a full contact across the entire width of tread, thereby distributing the wear evenly over the total surface of the entire tread area.

d. Cross or Toe Tread Wear

When the front wheels have an excessive amount of either toe-in or toe-out, the tires are actually dragged sideways when they travel straight down the road, and cross wear or scraping action takes place, rapidly wearing away the tread of tires. This cross wear condition will usually produce a tapered or feathered edge on the ribs of the tire tread. See Figure 7-4, View C. In most cases this can be detected by rubbing the hand across the tire tread.

If the tapered or feathered edges are on the inner sides of the ribs on one or both sides, it indicates that one or both tires have excessive toe-in, while the same condition in the outer sides of ribs indicate excessive toe-out. See paragraph 7-18 for toe-in correction.

Cases may be encountered where one front tire definitely indicates toe-in wear while the opposite tire indicates toe-out wear. Whenever this condition is indicated always check the steering geometry or turning angles of both front wheels as described in paragraph 7-18. It may be found that the turning angles are not according to specifications, so that the inside wheel on both turns either toes-in or toes-out too much, resulting in cross wear on turns only. Incorrect turning angles are caused by bent steering arms.

Cornering wear caused by high speed driving on curves (subpar. f, below) sometimes has the appearance of toe wear. Care must be used to distinguish between these two types of wear so that the proper corrective measures will be used.

e. Side or Camber Wear

Excessive wheel camber, either positive or negative, causes the tire to run at such an angle to the road surface that one side of the tread wears much more than the other. See Figure 7-4, View D.

The amount or angle of the camber wear will be governed by the amount of positive or negative camber in relation to the perpendicular, and by the shape of the road surface. With any given camber angle, tires driven on modern flat concrete highways will show greater camber wear than when driven on the earlier type crowned highways. Camber

wear may or may not be smooth or uniform, depending largely on the tire tread design.

Tire tread wear very similar in appearance to camber wear may be caused by driving on turns at excessive speeds. This "cornering" tread wear (subpar. f, below) cannot be corrected by change of camber angle.

Adjustments for specified camber is covered in paragraph 7-18.

f. Cornering Tread Wear

The modern independently sprung automobile allows the driver to negotiate turns at a high rate of speed with a greater feeling of safety. This fact is responsible for a comparatively new type of tread wear that can easily be mistaken for toe or camber wear.

When a car is making a turn, the tires are supposed to be rolling in a circle. When the turn is made at high speed, however, centrifugal force acting on the car causes the tires to be distorted sideways and to slip or skid on the road surface. This produces a diagonal cross type of wear, which in severe cases will result in a fin or sharp edge on each rib of the tire treads.

Cornering wear can be distinguished from toe or camber wear by the rounding of the outside shoulder of the tire, and by the roughening of tread surface in this section denoting severe abrasion. See Figure 7-4, View E.

No alignment or tire pressure change can be made that will relieve cornering wear. Only the driver can effect a cure, and that is by slowing down on curves.

g. Heel and Toe Tread Wear

Heel and toe wear is a saw-tooth effect with one end of each tread block worn more than the other. The end which wears is that which first grips the road when the brakes are applied. High speed driving and excessive use of the brakes will cause this type of irregular tire wear. This type of wear will occur on any type of block tread design. See Figure 7-4, View F.

Heel and toe wear is not so prevalent on the rear tires because of the propelling action which creates a counteracting force which wears the opposite end of the tread block. These two stresses on the rear tires wear the thread blocks in opposite directions and result in more even wear, while on the front tires the braking stress is the only one which is effective. This may be counteracted by interchanging tires (par. 7-8).

A small amount of irregular wear, slightly saw-toothed in appearance, at the outer segments of tires is a normal condition and is due to the difference in circumference between the center and the outer edges of the tire tread. This saw-toothed appearance, however, will be exaggerated by underinflation, improper toe-in, or both.

h. Wavy Tread Wear, Flat Spots, and Cupping

Many combinations of factors may cause the types of tread wear listed here; therefore it is never possible to say definitely that any one condition is the cause.

As stated above (subpar. g) a small amount of irregular wear at the outer segments of tires is a normal condition; however, irregular wear extending toward center of tread is due to wheel misalignment conditions which should be corrected. Careful checking and adjustment of all wheel alignment factors (par. 7-18) will reduce such wear.

An overinflated tire tends to bounce instead of keeping in contact with the road surface. On turns this bouncing produces scuffing and may cause flat spots to develop.

A tire that is statically unbalanced bounces or hops on the road, causing rapid and uneven tread wear.

High speed driving on straight highways or expressways over extended periods can also cause irregular wear or cupping. Tires should be switched regularly as shown in Figure 7-6.

Uneven brake adjustment or grabbing brakes will cause rapid and uneven tread wear. Out of round brake drums will cause flat spots to develop on tire treads.

Wobble or runout of a tire, either front or rear, due to bent wheel or to tire being improperly mounted will cause uneven wear. The runout of wheel and tire when rotated should not exceed dimensions shown in Figure 7-5.

Looseness of parts in the suspension system such as worn steering knuckle ball joints, loose wheel bearings, inoperative shock absorbers, and any excessive looseness throughout the steering system all tend to allow the front wheels to kick around, and if any of the wheel alignment factors are incorrect, irregular spotty tire tread wear of one type or another may result.

Regardless of the original cause of spotty tread wear on either front tire, no alignment or balance job, however perfect, can prevent future excessive wear of the spots. Once a front tire acquires flat or cupped spots extra rapid wear will continue, caused by the braking and steering strains on the thinner and weaker sections of the tread.

A thorough mechanical and alignment inspection, plus a check for wheel and tire unbalance should uncover the cause or causes of the irregular wear. At the time of correction, however, the cupped

tire should be interchanged with a rear tire on which the tread runs true. The cupped tire will, to a certain degree, true itself up on a rear wheel because of being rigidly mounted to the axle shaft it can only revolve, absorbing first the driving and then the braking strain.

Both front shock absorbers should provide the same feeling of resistance and both rear shock absorbers should do likewise. Any noticeable variation between right and left shock absorbers indicate that one unit is not operating normally. Little or no resistance on compression or rebound indicates air in shock absorbers, internal leakage due to wear, or that the valve is held open by dirt. Excessive resistance indicates that bleeder hole in valve is plugged with dirt.

If there is any doubt about the action of a shock absorber after testing as described above, remove the unit from car. Mount it vertically in vise with safe jaws gripping the mounting eye firmly, then move the piston rod up and down by hand. There should be no free movement in this test. Lack of resistance to movement indicates air in the shock absorber, internal leakage due to wear, or that the valve is held open by dirt. A faulty shock absorber must be replaced as it cannot be disassembled for repairs.

In the test given above, the amount of force that can be applied is not sufficient to open a valve against its spring pressure; therefore, this test only checks the flow of fluid through the valve bleeder hole as well as any leakage due to a valve being held open, or due to internal wear of piston and cylinder. Since it is unlikely that the valve springs will weaken in service, it may be assumed that the shock absorber action is normal if it operates satisfactorily in the test given above.

7-5 FAULTY SPRINGS, SHOCK ABSORBERS OR BALL JOINTS

a. Springs

Measurement of the trim dimension with springs installed is the only practical method of checking chassis springs that are reported to be weak. See paragraph 7-13 for checking trim dimension. The strength of chassis springs cannot be determined by measurement of the free length when removed from car, because springs of equal strength under rated load may vary considerably in length when not loaded.

b. Weak or Inoperative Shock Absorbers

Many shock absorbers have been replaced and returned to the factory with the report that they were weak. When tested with special factory equipment very few of these replaced units have been found weak or otherwise below standard in operation. This indicates that these shock absorbers were needlessly replaced in an attempt to improve riding conditions that were actually standard, or that erroneous methods were used in judging the operating condition of the units.

Before attempting to test shock absorbers make sure that all attaching bolts and nuts are tight. Tires should be uniformly inflated to specified pressure (par. 1-2). The chassis should be well lubricated to make sure that suspension parts are free moving.

Test each front and rear shock absorber in turn by quickly pushing down and then lifting up on the end of the car bumper adjacent to the unit being checked. Use the same force as near as possible on each test, and note the amount of resistance provided by the shock absorber on compression and rebound. A little practice on another car of the same model which has satisfactory ride control will aid in judging the amount of resistance that should exist.

c. Loose Ball Joints

The upper ball stud is spring-equipped and thus preloaded in its socket at all times. This minimizes looseness at this point and compensates for normal wear. If the upper stud has any perceptible shake, or if it can be twisted in its socket with the fingers, the upper ball joint should be replaced.

The lower ball joint is not spring loaded but firmly seated by the weight of the car. With the chassis spring load removed from the ball joint, this ball joint may show looseness. Such looseness is probably due to normal operating clearance.

7-6 IMPROPER STEERING ACTION

Steering action is dependent upon the chassis suspension members as well as the steering gear assembly and tie rods. Improper steering actions which are most likely to be caused by chassis suspension are covered in this paragraph, while conditions most likely to be caused by the steering gear assembly or tie rods are covered in paragraph 8-3.

a. Car Pulls or Leads to One Side

(1) High crowned roads.

(2) Low or uneven tire pressure (par. 1-2).

(3) Front tires of unequal diameter due to wear.

(4) Brakes dragging on one side (par. 9-8).

(5) Shock absorbers leaking or inoperative (par. 7-5).

(6) Incorrect caster, camber, or toe of front wheels (par. 7-18).

(7) Frame bent or broken.

b. Steering Affected by Application of Brakes

(1) Low or uneven tire pressure (par. 1-2).

(2) Front tires of unequal diameter due to wear.

(3) Incorrect or uneven caster or bent steering knuckle (par. 7-18).

c. Car Wander or Lack of Steering Stability

(1) Heavy cross wind.

(2) Type of road surface.

(3) Low or uneven tire pressure (par. 1-2).

(4) Wheels toe out in straight ahead position (par. 7-18).

(5) Incorrect or uneven caster or camber (par. 7-18).

(6) Steering gear or tire rods adjusted too loose or worn, or adjusted too tight (par. 8-4).

(7) No lubrication in ball joints or upper ball joint worn (par. 7-5).

d. Road Shocks Transmitted to Steering Wheel

(1) Low or high tire pressure (par. 1-2).

(2) Wrong type or size of tires used (par.7-1).

(3) Uneven tire wear (especially shoulder or cornering wear) (par. 7-4).

(4) Steering gear or tie rods incorrectly adjusted. Broken tie rod spring (par. 8-4).

(5) Shock absorbers inoperative or leaking (par. 7-5). Wrong valving (par. 7-1).

(6) Improper caster or bent steering knuckle (par. 7-18).

(7) Steering knuckle upper ball joint worn (par. 7-11).

e. Front Wheel Shimmy (low speed)

Low speed shimmy is a rapid series of oscillations of the front wheel and tire assembly as the wheels attempt to point alternately to the right and left. This movement is often transmitted through the steering linkage to the steering gear. Low speed shimmy usually occurs below 30 MPH.

(1) Uneven or low tire pressure (par. 1-2).

(2) One or both wheel and tire assemblies out of balance (par. 7-8).

(3) Front wheel bearings loose or worn (par. 7-10).

(4) Incorrect alignment of front wheels (par. 7-18).

(5) Steering knuckle upper ball joint worn (par. 7-11).

(6) Steering gear or tie rods incorrectly adjusted or worn (par. 8-4).

f. Wheel Tramp, Front or Rear

Wheel tramp, sometimes called high speed shimmy, is a rapid up and down movement of a wheel and tire assembly, as though the tire was decidedly eccentric. In severe cases the tire actually hops clear of the road surface. Wheel tramp may develop in either front or rear wheels, and occurs at speeds above 35 MPH.

(1) Wheel tire or brake drum out of balance (par. 7-8).

(2) Shock absorber inoperative (par. 7-5).

(3) Item 1 or 2 in combination with one or more items listed under Front Wheel Shimmy (subpar. e, above).

7-7 CAR ROUGHNESS OR VIBRATION

a. Various Causes

Car roughness or vibration may be caused by road surface conditions as some types of road set up unusual vibrations in cars at various speeds. Testing the car on a different type of road is causing the vibration.

Some types of tire treads, tires with more than four plies of fabric, or tires of greater weight than those chosen for production may cause abnormal vibration or roughness. If car is equipped with tires other than those which have been selected for production equipment (par. 7-1) it is advisable to test the car with standard tire equipment before deciding that a mechanical condition is the cause of roughness.

The following procedure should be used to determine cause of roughness or vibration in car operation at various speeds, which may be due to an unbalanced condition of wheels, tires, brake drums, propeller shaft, or engine.

1. Jack up all wheels, having jack support rear end of car at center of rear axle housing.

2. Check runout of front and rear wheels and tires. Runout should not exceed specifications shown in Figure 7-5. See subparagraph b, below.

3. With transmission in Direct Drive run engine at various car speeds to note speeds at which vibration or roughness occurs.

4. Remove rear wheels and run engine again at the critical speeds noted in Step 3. If roughness is gone the condition is caused by unbalanced wheel and tire assemblies (par. 7-8).

5. If roughness still exists with rear wheels removed, remove rear brake drums and repeat the running test. Elimination of the roughness indicates out of balance brake drums (par. 9-12).

6. If roughness still exists with brake drums removed, run engine with transmission in Neutral. Elimination of the roughness indicates that propeller shaft is out of balance. Continued roughness with engine running alone indicates an out of balance condition of engine.

b. Tire and Wheel Runout

Excessive vibration or shake similar to out of balanced tires can be caused by excessive tire or wheel runout. This runout consists of both radial and lateral. Radial runout usually has greater affect on vibration or shake than lateral runout.

A dial indicator may be used to check runout on wheel and tire assemblies at points shown on Figure 7-5. Tire runout should be checked immediately after the car has been driven, as tires take a "set" after standing for a short period. NOTE: It should be stressed that the runout found is a mere indication and not proof of the source of trouble.

Procedure:

1. Make certain that the wheel lug nuts are tightened adequately and evenly.

2. If checking front wheels and tires make certain that wheel bearings are correctly adjusted.

3. Mount the dial indicator on a firm base and check total indicator runout at the points indicated in Figure 7-5.

4. If runout exceeds specifications check for the source of the trouble and correct as necessary.

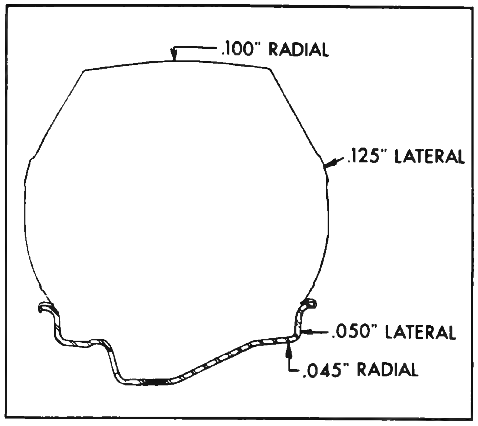


Figure 7-5—Runout Limit Specifications

SECTION 7-C
SERVICE, ADJUSTMENT, AND REPLACEMENT PROCEDURES—CHASSIS SUSPENSION

CONTENTS OF SECTION 7-C

7-8 TIRE SERVICE AND INSPECTION

a. Tire Inflation and Inspection

Maintenance of correct inflation pressure in all tires is one of the most important elements of tire care. Correct tire pressure is also of great importance to ease of handling and riding comfort. Overinflation is detrimental to tire life but not so much as underinflation. Inflate all tires according to tire temperature as specified in paragraph 1-2.

Driving without valve caps contributes to underinflated tires. The valve cap keeps dirt and water out of the valve core and seals the valve against leakage. Whenever tires are inflated be sure to install valve caps and tighten firmly by hand. Make sure that rubber washer in cap is not damaged or missing.

If tires are checked at frequent intervals and adjusted to correct inflation pressure, it is often possible to detect punctures and make a correction before a tire goes flat, which may severely damage tire if car is in motion. Slight differences in pressure between tires will always be found, but a tire that is found to be 3 or more pounds below the lowest of its running mates can be suspected of having a leaking valve or a puncture.

All tires should be inspected regularly to avoid abnormal deterioration from preventable causes. If tires show abnormal or uneven wear the cause should be determined and correction should be made.

See that no metal or other foreign material is imbedded in the tread. Any such material should be removed to prevent damage to tread and tire carcass. Cuts in a tire which are deep enough to expose the cords will allow dirt and moisture to work into the carcass and ruin the tire unless promptly repaired.

b. Tubeless Tire Repairs

A leak in a tubeless tire may be located by inflating the tire to recommended pressure (par. 1-2) and then submerging tire and wheel assembly in water, or by applying water to tire with a hose if wheel is mounted on car. Remove water from area where air bubbles show and mark the area with crayon. After removal of the puncturing object from tire, the puncture must be sealed to prevent entrance of dirt and water which would cause damage to the tire carcass.

A small puncture of less than 3/32" diameter may be sealed without removal of tire from wheel by injecting sealing dough with a gun. Punctures up to 1/4" diameter may be sealed by installation of a rubber plug with cement, after tire has been removed from wheel. Sealing dough with gun, and rubber plugs with cement are contained in tire repair kits available through tire dealers. These materials should be used as directed in the instructions supplied with the kits. If a puncture is larger than 1/4" or there is other damage to the tire carcass, repairs should be made by authorized tire dealers in accordance with instructions of the tire manufacturer.

c. Wheel Leaks

Examine rim flanges for sharp dents. Any dent visible to the eye should be straightened. The rim flanges should be thoroughly cleaned with No. 3 coarse steel wool thereby removing all oxidized rubber, soap solution, etc. If the flange is rusted, it can be cleaned with a wire brush or in extreme cases of pitted rims a file can be used.

In isolated cases loss of air may result from loose rivets or porous welds. If the leak is minute and the rivet is not perceptibly loose, the leak can be sealed with a cement available from tire manufacturers for this purpose. If the rivet is noticeably loose or the air leak is large replace the wheel.

CAUTION: Under no condition should loose rivets or porous welds be brazed, welded or peened.

d. Demounting and Mounting of Tubeless Tire

When demounting a tubeless tire use care to avoid damaging the rim-seal ridges on tire beads. A "bead breaker" is recommended for loosening the beads. DO NOT USE TIRE IRONS TO FORCE BEADS AWAY FROM WHEEL RIM FLANGES. After both beads are broken loose from wheel rim flanges, remove tire in usual manner, starting at the valve stem, and using care to avoid damaging rim-seal ridges.

When tire is removed, inspect it carefully to determine whether loss of air was caused by puncture or by improper fit of beads against rim flanges. If improper fit is indicated, check wheel as follows:

(1) Straighten wheel rim flanges if bent or dented.

(2) Clean rims thoroughly, using No. 3 coarse steel wool, to remove all oxidized rubber, soap solution, etc. Remove rust with wire brush.

(3) Inspect butt weld and other areas of rim contacted by tire beads, to make certain there is no groove or high spot. Remove any groove or high spot by filing smooth.

(4) Inspect valve stem and replace it if damaged. Make certain that valve stem is properly installed to provide an air tight joint.

Before mounting a tubeless tire on a wheel remove cardboard spacer, if tire is new. Moisten a cloth with mounting compound or solution and wipe rim-seal ridges of both beads to remove all foreign substance. Moisten base of both beads with mounting compound or soap solution to help beads snap into place when tire is inflated. Start tire over rim frange at point opposite valve stem, so that valve stem cannot prevent bead from dropping into the well as last section of bead is forced over the rim flange. Align balance mark on tire with valve stem.

Either a tire mounting machine or tire irons may be used; however, parts of tools contacting tire beads must be smooth and clean to avoid damaging rim-seal ridges. Take small bites if tire irons are used. DO NOT USE HAMMERS.

CAUTION: Due to the violence with which the outer tire bead seats to the rim, it is recommended than an extension gauge with a clip-on check be used for mounting inflation. This will allow the operator to remain at a safe distance.

Remove valve core to increase flow of air during inflation. Hold tire and wheel assembly in vertical position and bounce on floor at various points around circumference to snap beads out against rim flanges. If seal cannot be effected in the foregoing manner with the rush of air, apply a tourniquet of heavy sash cord around circumference to tire and tighten it with a tire iron to force beads outward.

Inflate tire until both beads are firmly seated against rim flanges, then remove air chuck, insert valve core and temporarily inflate to 50 pounds pressure. Leak test wheel and tire assembly under water, and if satisfactory reduce to recommended pressure (par. 1-2).

e. Interchanging Tires

Tires tend to wear unevenly and become unbalanced as mileage accumulates. Uneven tire wear is frequently the cause of tire noises which are attributed to rear axle gears, bearings, etc., and work is sometimes needlessly done on rear axles in an endeavor to correct the noise.

Tire life will be increased and uneven wear and noise will be less likely to occur if the tires, including the spare, are balanced and interchanged at regular intervals of approximately 5000 miles. The recommended method of interchanging tires is shown in Figure 7-6.

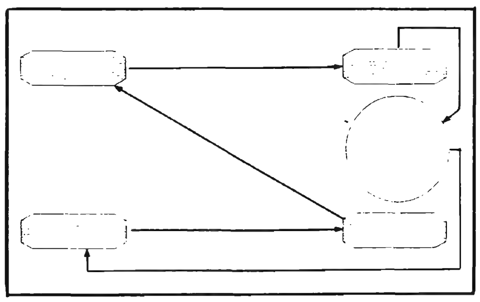


Figure 7-6—Method of Interchanging Tires

f. Use of Tire Chains

Do not use tire chains on the front wheels under any circumstances because they will interfere with the steering mechanism. Any of the conventional full-type non-skid tire chains can be used on the rear wheels.

Tire chains should be loose enough to "creep" but tight enough to avoid striking fenders or other parts. If chains remain in one position the tire side wall will be damaged. Tension springs (either metal coil springs or the rubber band type) must also be

used in order to prevent chains contacting frame, etc. The use of tension springs will also reduce ordinary chain noise caused by loose cross links contacting pavement.

g. Wheel and Tire Balance

Wheel and tire balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. Wheel unbalance is the principal cause of tramp and general car shake and roughness, and contributes somewhat to steering troubles.

All wheel and tire assemblies are statically balanced to within 6 inch ounces when assembled at the factory. After installation on the car, the complete assembly may be dynamically balanced if necessary or desired.

The original balance of the tire and wheel assembly may change as the tire wears. Severe acceleration, severe brake applications, fast cornering and side slip wear the tires out in spots and often upset the original balance condition and make it desirable to rebalance the tire and wheel as an assembly. Tire and wheel assemblies should be rebalanced after punctures are repaired.

Because of the speed at which cars are driven it is important to test the wheel and tire assembly for dynamic balance. Dynamic balancing of a wheel and tire assembly must be done on a machine designed to indicate out of balance conditions while the wheel is rotating. Since procedures differ with different machines, the instructions of the equipment manufacturer must be carefully followed.

In some cases wheel and tire balance does not always overcome wheel balance complaints because the brake drums themselves are out of balance. Balancing drums with wheels and tires as an assembly is not always satisfactory because the balance is destroyed when wheels and tires are removed or interchanged. On cars where trouble is experienced in maintaining proper wheel balance, it is suggested that all drums be individually checked for static balance and corrected, if necessary, as described under Brake Drum Balance (par. 9-12).

7-9 REPLACE STABILIZER LINK GROMMETS

The construction of the stabilizer links is shown in Figure 7-7. Neoprene grommets are used at the lower ends of the stabilizer links for grease resistance. This offers protection from chassis lube overflow from the lower ball joints.

The upper stabilizer grommets are rubber as they are out in the open where grease resistance is not required.

To disassemble, remove nut from lower end of the link rod, then remove rod, spacer, retainers, and grommets. When new, the link grommets are 7/8" free length. When assembling, install rubber grommets dry and use care to center the grommets in the seats on stabilizer shaft and lower control arm plate, also center the retainers on grommets before tightening rod nut. Tighten rod nut to 7 ft. lbs.

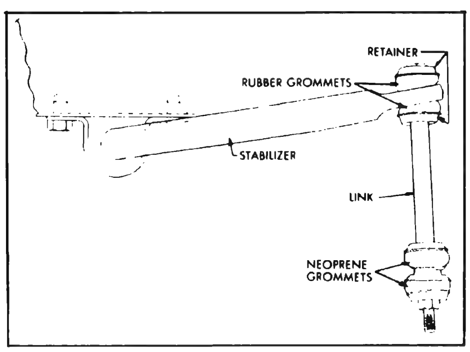


Figure 7-7—Front Stabilizer Link

7-10 REPLACE AND ADJUST FRONT WHEEL BEARINGS

a. Replacement of Bearings

1. Remove wheel with hub and drum assembly. Remove oil seal from hub so that inner bearing can be properly cleaned and inspected.

2. Wipe old grease out of hub and from steering knuckle spindle. Clean and inspect all bearing parts, and replace any that are faulty.

3. If a bearing cup outer race has to be replaced, drive the old cup out with a punch. Use care when installing the new cup to start it squarely into hub, to avoid distortion and possible cracking.

4. When inspecting or replacing bearing cones (inner races) make sure that cones are free to creep on spindle of steering knuckle. The cones are designed to creep on the spindle in order to afford a constantly changing load contact between the cones and the roller bearings. Polishing the spindle and applying bearing lubricant will permit creeping and prevent rust forming between cone and spindle.

5. Wash and thoroughly dry all bearing parts, because wheel bearing lubricant will not adhere to oily surfaces.

6. Thoroughly pack both bearing assemblies with new wheel bearing lubricant, preferably using a bearing packer. If packer is not available, work lubricant into bearings by hand. In either case, remove any surplus lubricant.

7. Apply a light coating of lubricant to spindle and inside surface of wheel hub to prevent rusting.

8. Place inner bearing assembly in cup and install a new oil seal, driving seal squarely into hub with Installer J-6541. Carefully install inner bearing cone in oil

seal. NOTE: Never place cone on spindle because seal will be damaged as wheel is installed.

9. Install wheel on spindle, then install outer bearing assembly, cone, safety washer and nut. See Figure 7-8.

10. Adjust bearings as follows (subpar. b).

b. Adjustment of Front Wheel Ball Bearings

1. Torque spindle nut to 19 ft. lbs. while rotating wheel.

2. Back off nut until bearings are loose.

3. Retighten nut to 11 ft. lbs. torque while rotating wheel.

4. If either cotter pin hole in spindle lines up with slot in nut, back off nut 1/12 turn and install cotter pin. 1/6 turn is maximum allowable back-up to align hole with slot.

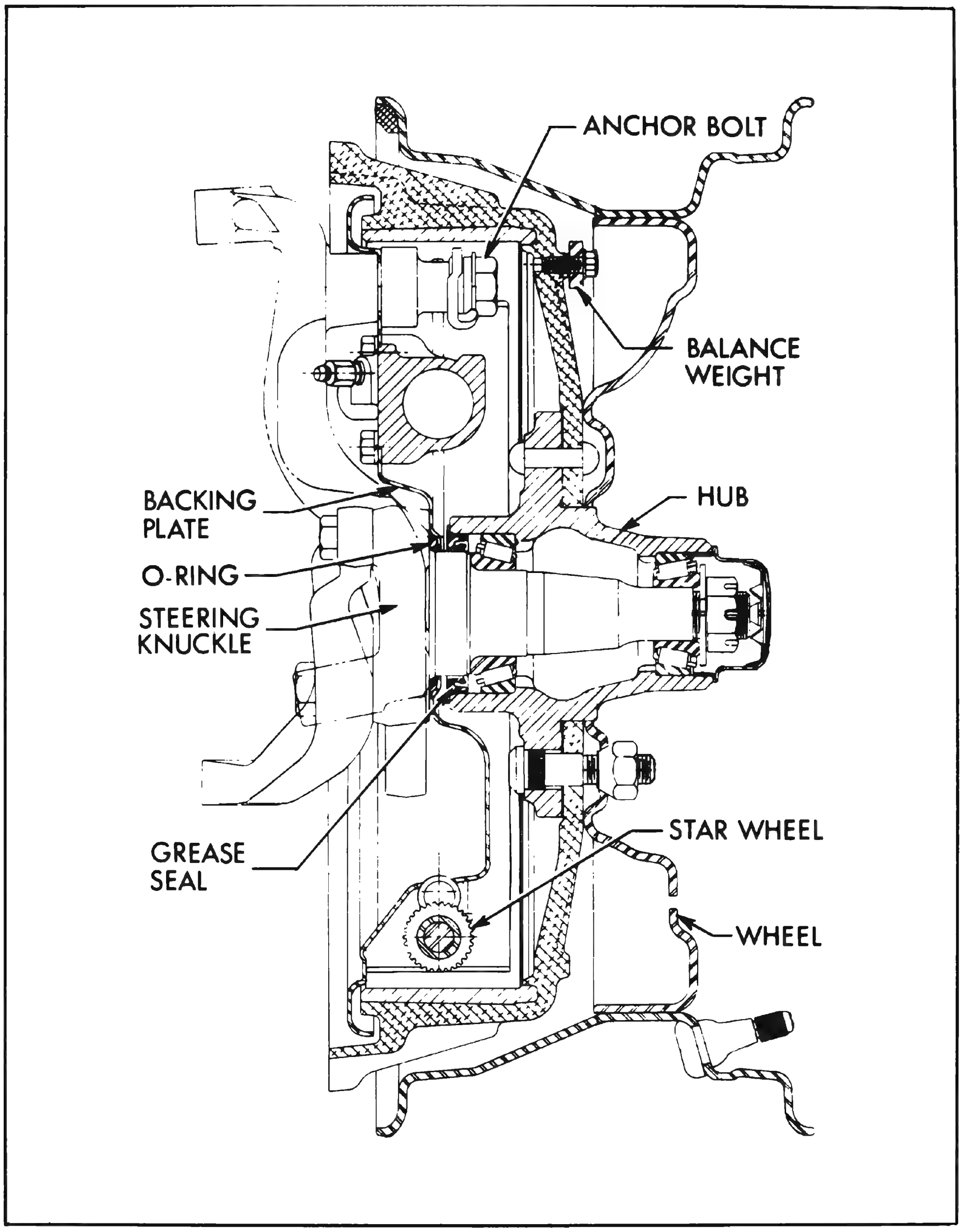


Figure 7-8—Front Wheel Hub and Bearings

7-11 REMOVAL AND INSTALLATION OF BALL JOINTS AND/ OR STEERING KNUCKLE

a. Removal and Installation of Upper Control Arm Ball Joint Assembly

The upper ball joint assembly is pressed into the upper control arm and is serviced only as a part of this upper control arm-ball joint assembly. The upper ball joint stud is spring loaded in its socket. If the upper stud has any perceptible shake, or if it can be twisted in its socket with the fingers, the upper control arm-ball joint assembly should be replaced. See Figure 7-9.

Removal

1. Raise car with jack under frame. Remove wheel and tire.

2. Remove cotter pin from castellated nut on upper ball joint tapered stud.

3. Loosen, but do not remove nut. Force of chassis spring will be tending to disengage ball joint tapered stud from steering knuckle. Rap knuckle sharply in area of tapered stud to disengage stud from knuckle. See Figure 7-19.

4. With another jack support car weight under outer edge of lower control arm and remove nut from ball joint tapered stud.

5. Now lower the jack placed under the lower control arm to slightly lower the knuckle, hub and drum assembly. Be careful to avoid damage to the brake hose.

6. Remove the upper control arm shaft to bracket nuts and lock washers, carefully noting the number, location, and thickness of adjusting shims between the shaft and frame bracket. Remove the control arm assembly.

7. Clamp the control arm assembly in a vise and remove the bushings, seals, and shaft. After cleaning away the old grease, examine the shaft and bushings for

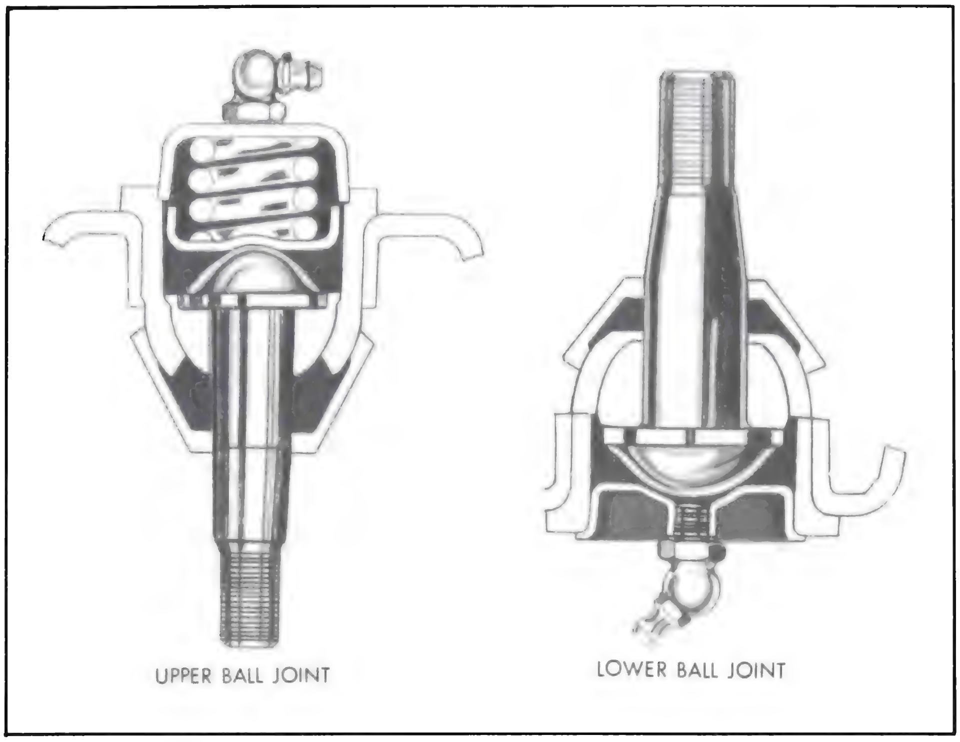


Figure 7-9—Upper and Lower Ball Joints

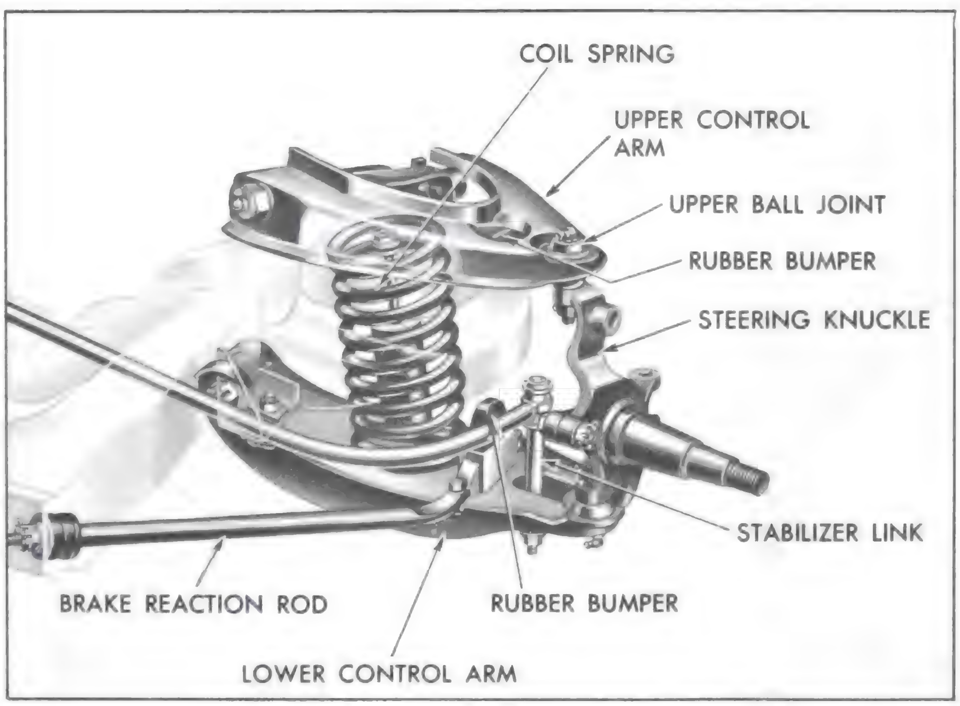


Figure 7-10—Front Suspension

excessive wear or damage. Replace any excessively worn parts.

Installation

1. Assemble new grease seals on the shaft. Apply a coating of good quality and long-effectiveness chassis lubricant to the shaft threads, and position the shaft in the new control arm-ball joint assembly.

2. Start bushing into upper control arm. Thread shaft into bushing to aid in alignment. Torque bushing to 70 ft. lbs. maximum.

3. Start second bushing into the upper control arm with shaft threaded into the opposite bushing. See Figure 7-11.

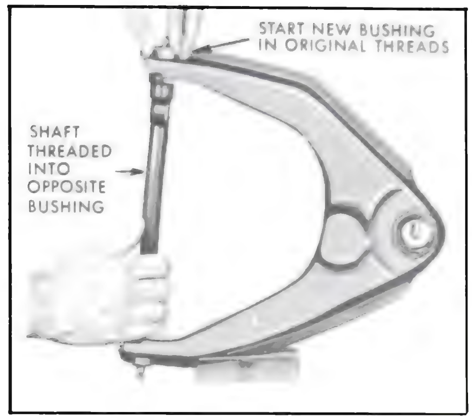


Figure 7-11—Upper Control Arm Bushing Replacement

4. After bushing has been threaded part way into arm, rotate shaft to engage threads of second bushing as an aid in piloting the bushing squarely into position.

5. Tighten bushing into arm until hex section of bushing seats firmly into arm. Torque to a minimum of 70 ft. lbs. Shaft should be free enough to turn by hand. Install grease fittings and lubricate bushings.

6. Rotate shaft to make distance between shaft bolt holes and arm equal both sides as nearly as possible. See Figure 7-12.

7. Assemble upper control arm and shaft assembly to bracket, making certain the number, thickness and location of adjusting shims between shaft and bracket are correct. Torque shaft to bracket nuts to 100 ft. lbs. The nuts may be torqued from with the engine compartment through the use of a standard 11/16"-1/2" drive socket and J-1313 Torque Wrench or its equivalent.

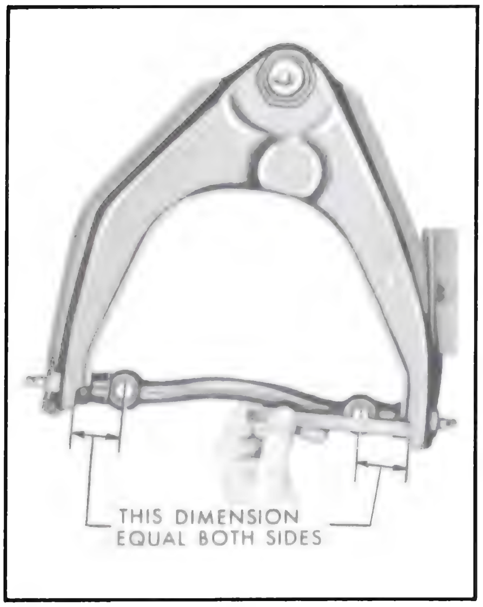


Figure 7-12—Upper Control Arm Shaft Position

8. Assemble tapered stud to knuckle with cotter pin holes fore and aft. Install castellated nut. Torque to 35 ft. lbs. and install cotter pin.

9. Install wheel. Check and adjust front end alignment if necessary.

When working in the area of the front upper control arm, make certain that the rubber water deflectors are securely attached in their original positions when the work is completed. If reasonable care is exercised in removing the fasteners for these rubber deflectors, they may be satisfactorily reused.

10. Lubricate the ball joint and upper control arm shaft bushings with a long-effectiveness grease equivalent to Buick Specification No. 742.

b. Lower Control Arm Ball Joint Assembly—Removal and Installation

The lower ball joint assembly is pressed into the lower control arm and is serviced separately. The lower ball joint is not spring equipped and depends upon car weight to load the ball. See Figure 7-9.

Before checking lower ball joints, the wheel bearing must be properly adjusted and the suspension must be freely suspended. The car should be supported at the frame rails on each side at the front end. DO NOT USE A JACK OR STANDS UNDER LOWER CONTROL ARMS. Place a dial indicator at the lower vertical edge of the wheel. With one hand at the top and the other at the bottom of the tire, moderately rock the wheel at the top and bottom. If more than 1/16" movement appears on the dial indicator the lower ball joint should be replaced.

Removal

1. Raise front of car and place jack stands under frame side rails. Remove wheel with hub and drum assembly.

2. Remove the brake backing plate. If the backing plate is wired carefully out of the way as shown in Figure 7-13, there will be no need to disconnect the brake hose.

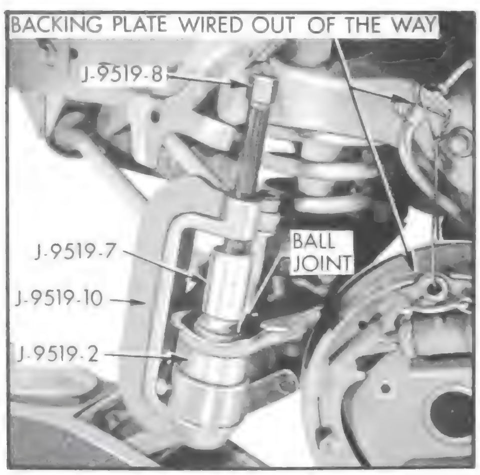


Figure 7-13—Lower Ball Joint Remover Tool in Place

3. For safety's sake place a floor jack under the lower control arm as far outboard on the arm as possible to gain maximum leverage advantage. Do not place the jack against the arm but about 1/2" below. Now remove cotter pin and loosen (do not remove) nut on lower ball joint tapered stud. Nut should be loosened not more than 1/8".

4. Rap the steering knuckle sharply in the area of the ball stud to allow the force of the chassis spring to disengage the tapered ball stud from the knuckle. NOTE: It is sometimes helpful to wedge a block of wood under the upper control arm to provide a solid stop so the lower ball stud can be loosened with a more solid hammer rap.

5. Place the jack under the lower control arm at the spring seat. Raise the jack until compression is relieved on the upper control arm rubber rebound bumper. Remove the stud nut. Move the steering knuckle out of the way.

6. Install Lower Ball Joint Remover and Installer J-9519 as shown in Figure 7-13. Note that the larger O.D. portion of Detail J-9519-2 is positioned in J-9519-10.

7. Tighten Detail J-9519-8 with a socket and handle as shown in Figure 7-14 until ball joint is forced out of the lower control arm. CAUTION: Ball joint may pop out suddenly.

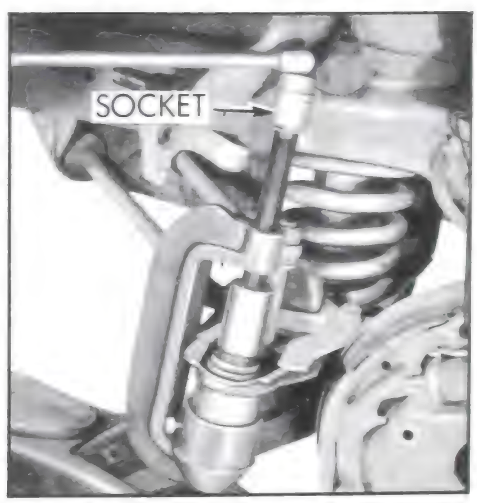


Figure 7-14—Removing Lower Ball Joint

Installation

1. Position ball joint minus dust shield in lower control arm and install Tool J-9519 as shown in Figure 7-15. Note that the larger O.D. portion of Tool Detail J-9519-2 is positioned in Detail J-9519-10.

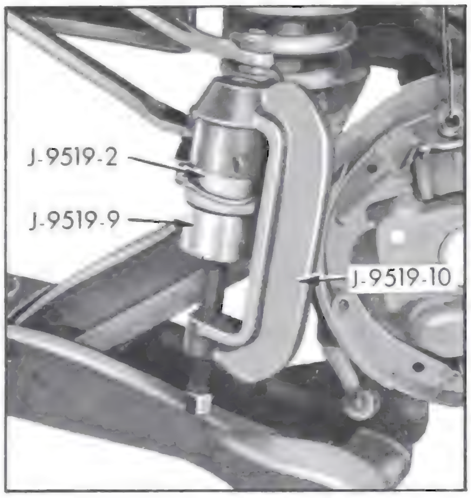


Figure 7-15—Lower Ball Joint Installer Tool in Place

2. With a suitable socket and handle force the ball joint into the lower control arm until it is fully seated. See Figure 7-16.

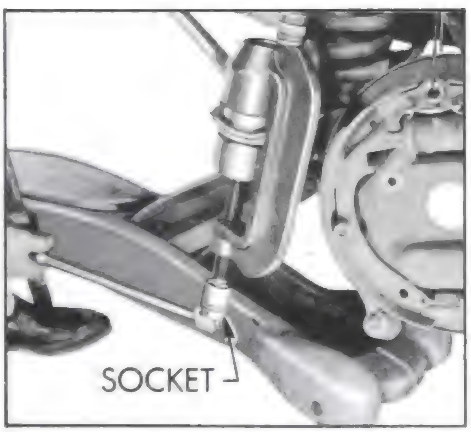


Figure 7-16—Installing Lower Ball Joint

3. Turn the stud so the cotter key hole is fore and aft, and assemble the rubber dust shield to the stud.

4. Position the tapered stud in the knuckle and install nut. Tighten the nut to 65 ft. lbs. and install cotter key.

5. Install wheel with hub and drum assembly. Adjust wheel bearings (par.7-10). Remove car stand and lower car.

NOTE: Upper and lower ball joints are similar in appearance but are not interchangeable.

c. Removal and Installation of Steering Knuckle

1. Follow Steps 1 thru 7 of subparagraph b., Removal of the Lower Ball Joint. Be certain to merely loosen the nut.

2. Remove cotter pin and loosen (Do Not Remove) nut on upper ball joint tapered stud. Nut should be loosened not more than 1/8".

3. Rap steering knuckle in area of stud on both upper and lower ball joints to separate studs from knuckle. Nuts that were previously loosened still hold upper and lower control arms to knuckle.

4. Making certain that the lower control arm is adequately supported by a jack on its outer extremities to prevent any downward travel of the lower control arm when removing ball joint nut, (it may be necessary to actually raise the lower control arm slightly to remove force of the knuckle against the nut) remove the nut and raise knuckle off tapered stud.

5. The upper ball joint is already loosened from the knuckle, and with no spring force to interfere, it is now possible to remove the nut from the tapered stud and thus remove the knuckle.

6. To replace knuckle, wipe stud of upper ball joint clean, assemble to knuckle with cotter pin hole fore and aft, seat with sharp blow of hammer, torque nut to 35 ft.lbs. and install cotter pin.

7. Wipe lower ball joint stud clean and assemble to knuckle as outlined in installation Steps 1 thru 5 subparagraph b, above.

7-12 REMOVAL AND INSTALLATION OF UPPER CONTROL ARM OR SHAFT

The removal and installation of the Upper Control Arm and Shaft is covered in paragraph 7-11 under a. Upper Control Arm-Ball Joint Assembly Removal and Installation.

7-13 CHASSIS SPRINGS

a. Checking Spring Trim Dimensions

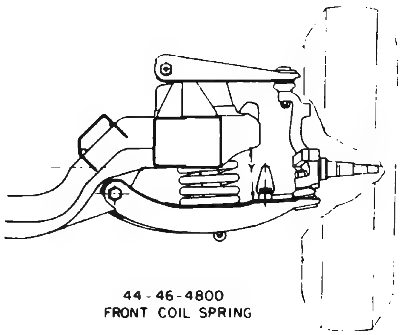
Optional equipment, undercoating, accumulated dirt, etc., changes the car weight and must be considered when checking spring trim dimensions. Because of the many possible variations in loading due to optional equipment it is not possible to give dimensions for all; therefore, the spring trim dimensions given below are for the standard car only, without optional equipment or undercoating and with car at curb weight. Curb weight includes gas, oil, water, and spare tire but no passengers.

Before measuring spring trim dimensions, bounce both ends of car up and down several times to make sure there is no bind in suspension members, and to let springs take a natural position. When car is at rest, measure the trim height at point "Y" for front spring or point "Z" for rear spring, as indicated in Figure 7-17.

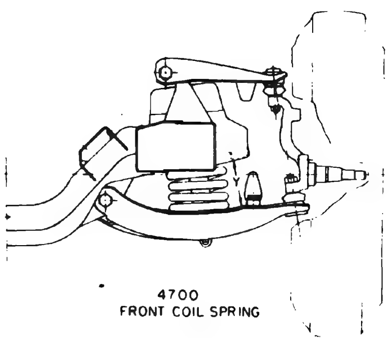
(1) Front Springs. On a car having service miles the front spring trim-dimension "Y" should be as shown in Figure 7-17 chart.

NOTE: When checking NEW car add 1/4".

When the front spring trim dimension is found to be too low,



44-46-4800
FRONT COIL SPRING



4700
FRONT COIL SPRING

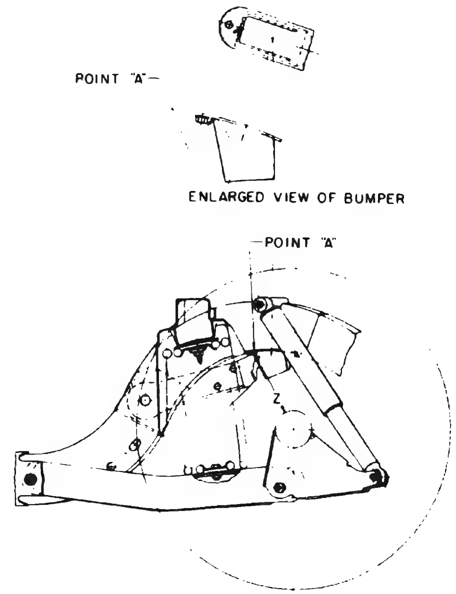
CHASSIS TRIM DIMENSION 1963

MODEL	FRONT COIL Y:18 CURB WEIGHT	FRONT COIL Y:18 NORMAL LOAD (DESIGN)	FRONT COIL Y:18 NORMAL LOAD (ACTUAL)	REAR COIL Z:24 CURB WEIGHT	REAR COIL Z:24 NORMAL LOAD (DESIGN)	REAR COIL Z:24 NORMAL LOAD (ACTUAL)
4411	5.23	4.52	4.36	7.25	6.04	5.34
4435	5.23	4.52	4.46	7.00	6.04	5.73
4439	5.23	4.52	4.36	7.25	6.04	5.34
4445	5.23	4.52	4.46	7.00	6.04	5.73
4447	5.23	4.52	4.36	7.25	6.04	5.34
4467	5.23	4.52	4.36	7.25	6.04	5.34
4469	5.23	4.52	4.36	7.25	6.04	5.34
4635	5.23	4.52	4.46	7.00	6.04	5.73
4639	5.23	4.52	4.36	7.25	6.04	5.34
4647	5.23	4.52	4.36	7.25	6.04	5.34
4667	5.23	4.52	4.36	7.25	6.04	5.34
4747	4.85	4.14	4.14	6.42	5.28	4.97
4819	5.23	4.52	4.39	7.25	6.14	5.53
4829	5.23	4.52	4.39	7.25	6.14	5.53
4839	5.23	4.52	4.39	7.25	6.14	5.53
4847	5.23	4.52	4.39	7.25	6.14	5.53
4867	5.23	4.52	4.39	7.25	6.14	5.53

THESE DIMENSIONS DO NOT APPLY TO OPTIONAL SPRINGS

4400 4600 4800
NORMAL LOAD TRIM DIMENSIONS DETERMINED WITH 4 PASSENGER LOAD, 2 PASSENGERS IN FRONT SEAT, 2 PASSENGERS IN REAR SEAT.

4700
NORMAL LOAD TRIM DIMENSIONS DETERMINED WITH 3 PASSENGER LOAD, 2 PASSENGERS IN FRONT SEAT, 1 PASSENGER IN REAR SEAT



44 46 4800
REAR COIL SPRING

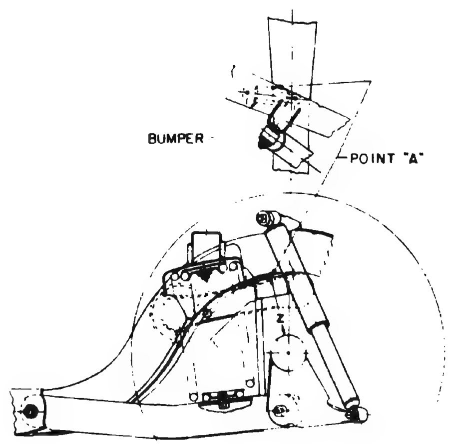


Figure 7-17—1964 Chassis Trim Dimensions

correction may be made by installing special shims (Group 7.425), 1/8" thick, between upper end of spring and the frame. If more than two shims are required, replace the spring.

(2) Rear Springs. On a car having service miles the rear spring trim dimension should be as shown on Figure 7-17 chart.

NOTE: When checking NEW car add 3/8".

If rear spring trim dimension is less than specified or additional height is required to prevent excessive "bottoming" in exceptional cases, install additional spring insulators (Group 7.545), divided between upper and lower ends of spring. If more than three additional insulators are required replace the spring. Installation of new springs should not increase trim dimension "A" more than 1" over specified maximum limit.

b. Front Coil Spring Removal and Installation

Removal

1. Raise front of car and support solidly with a car stand under the frame side rail on the side where the spring removal is to be performed. Car must be high enough to allow the lower control arm to be positioned nearly straight down with a jack placed beneath the ball stud end.

2. Remove wheel, brake drum and bearings. Take precautions against bearing damage from dirt, etc.

3. Remove the two bolts and nuts, and the anchor bolt holding the brake backing plate to the knuckle. Remove the backing plate but do not disconnect the brake hose. Support the backing plate in such a manner that the hose will not be damaged. Backing plate may be wired out of the way. See Figure 7-18.

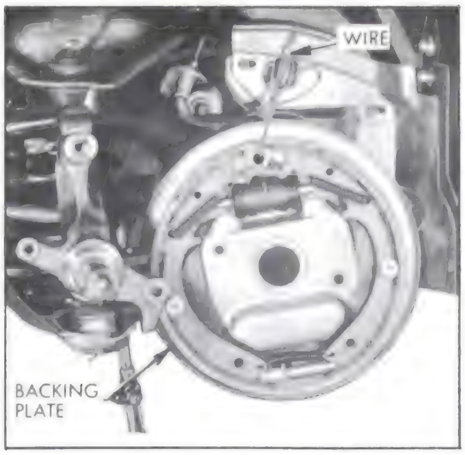


Figure 7-18—Wiring Brake Backing Plate Out of the Way

4. Remove the shock absorber. See paragraph 7-17.

5. Remove the front stabilizer rod link from the lower control arm. Place parts aside in their relative assembled position since the upper grommets are rubber while the lower ones are neoprene. They should be reassembled in this manner.

6. Disconnect the brake reaction rod and adjacent control arm bumper from the lower control arm but leave attached to the front frame cross member.

7. As a safety precaution place a floor jack under the lower control arm as far outboard on the arm as possible to gain maximum leverage advantage. It would be advantageous to remove the lube fitting at the lower ball joint so that it will not be damaged by the jack.

Do not place the jack against the arm, but about 1/2 inch below. Now remove the cotter pin and LOOSEN, DO NOT REMOVE the nut on the lower ball joint tapered stud. The nut should be loosened not more than 1/8".

8. Rap the steering knuckle in the area of the stud to separate the stud from the knuckle. See Figure 7-19. Raise the jack against the control arm to relieve pressure on the nut, remove the

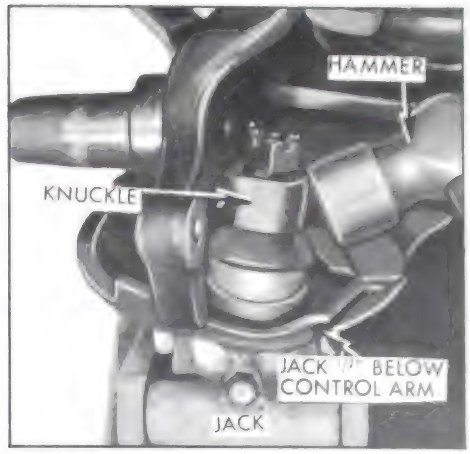


Figure 7-19—Separating Ball Stud From Knuckle

nut and separate the steering knuckle from the tapered stud.

9. Carefully lower the jack supporting the lower control arm to release the spring. With the jack all the way down to the floor it still may be necessary to pry the spring off its seat on the lower control arm with a long pry bar. See Figure 7-20. Caution should be exercised in handling this loaded spring while still attached.

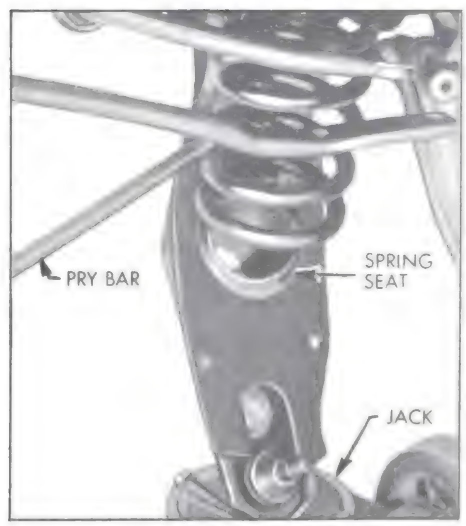


Figure 7-20—Prying Spring Off Its Seat

Installation

1. Position spring in frame upper spring seat. Align the lower end of the coil with the small hole in

Figure 7-21—Tool J-9552

the lower control arm. When assembled the end of the lower coil must be within 1/4" of this hole.

2. Place Plate J-7592-7 of spring installing Tool J-9552 between the 4th and 5th coil of the spring from the bottom. Step in plate will fit contour of the coil. Install bolt to plate and place threaded end of the bolt through the shock absorber hole in the frame spring seat.

3. Install special Nut J-9552-2 on the upper end of the bolts so that the shoulder of the nut protrudes through the hole in the upper spring seat to protect the threads of the bolt at this point.

4. Place a box wrench on the upper nut of the tool to keep it from turning. Now tighten the bolt with a 7/8" socket and extension. See Figure 7-22.

5. Tighten the bolt, compressing the spring, until at least 1-3/4" to 2" of the rod protrudes through the upper nut of the tool. At this point the spring is usually compressed sufficiently.

6. Force the spring on its seat in the lower control arm as shown in Figure 7-23. Remove tool.

7. With the spring in position raise the lower control arm with the jack and attach the lower ball joint tapered stud to the knuckle.

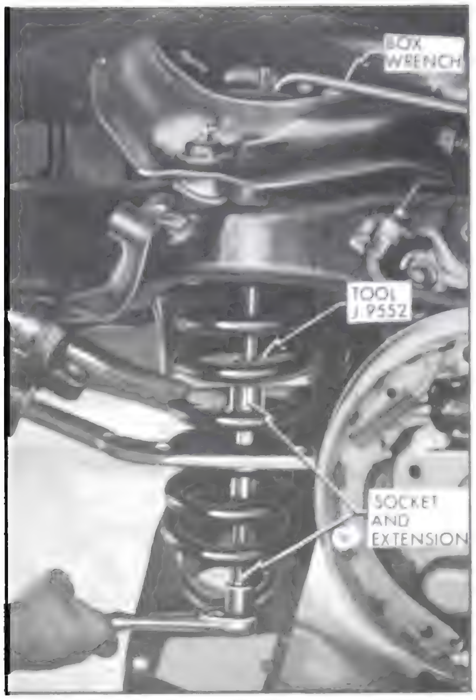


Figure 7-22—Compressing Front Spring With Tool J-9552

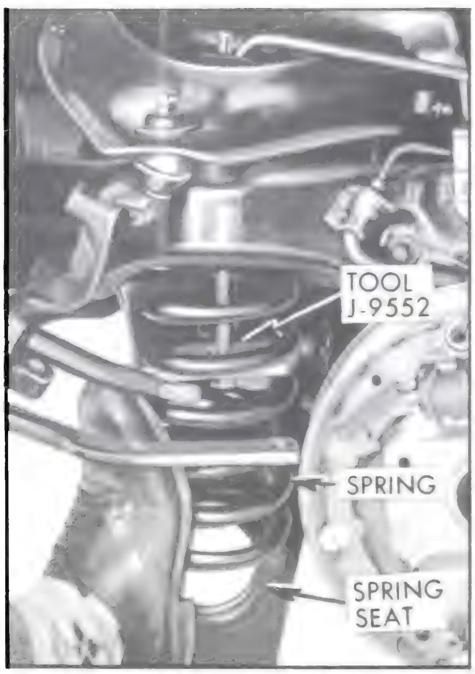


Figure 7-23—Pushing Spring on Lower Control Arm Seat

Make certain that the rubber dust cover is in place on the ball joint. Torque the nut to 70 ft. lbs. and install the cotter pin.

8. Install shock absorber. Torque upper nut to 10 ft. lbs., and lower bolts to 20 ft. lbs.

9. Attach brake reaction rod and compression bumper to the lower control arm. Torque the nuts to 90 ft. lbs.

NOTE: Never use standard bolts, nuts or washers at this location. If replacement parts are needed package, Group 6.171, Part 1389760, contains the two special nuts and four special washers necessary for this installation.

10. Reinstall stabilizer link and grommets. Assemble in same relative position as maintained after removal so that rubber grommets are on the stabilizer end while the neoprene grommets are at the lower control arm end of the link. See Figure 7-7.

11. Reinstall backing plate to knuckle making certain that "O" ring is in place on the spindle. Tighten front steering arm bolt nut to 45 ft. lbs.,rear bolt nut to 70 ft. lbs. and anchor bolt to 140 ft. lbs.

12. Wipe any accumulated dirt off the spindle and lightly lube with wheel bearing lubricant. Install outer roller bearing and special washer.

13. Install spindle castellated nut.

a. Torque spindle nut to 19 ft. lbs. while rotating wheel.

b. Back off nut until bearings are loose.

c. Retighten nut to 11 ft. lbs. torque while rotating wheel.

d. Back off nut at least 1/12 turn but not more than 1/6 turn, and install cotter pin. Bend ends of cotter pin so they do not interfere with the static collector in the dust cap.

14. Reinstall the lower ball joint grease fitting. Remove the car stand and recheck and adjust toe-in as necessary.

c. Rear Coil Spring Removal and Installation

Removal

1. Raise rear end of car and support on frame stands.

2. Mark universal joint and pinion companion flange for correct reinstallation. This maintains the balance between these two parts as installed during original assembly. Disconnect by removing U-bolt clamps at pinion flange.

3. Slide propeller shaft forward on slip spline far enough to clear rear companion flange. Wire or otherwise suitably support propeller shaft up out of the way to prevent damage to constant velocity universal joint center ball by allowing it to bend to the end of its travel.

4. Remove bolt attaching brake line bracket to rear suspension cross member to provide slack in brake line.

5. Position jack under control arm below axle housing and raise jack slightly to relieve tension on shock absorber.

6. Disconnect shock absorber at axle bracket by removing nut and bolt.

7. Remove nut from lower spring clamp bolt and carefully lower jack to fully extend spring and remove bolt and spring clamp from lower control arm. Upper spring clamp can now be removed.

CAUTION: Do not completely lower jack as this will cause strain on brake hose.

Installation

1. Assembly upper insulators on stud between frame and top of spring. Position top of spring up against insulator and assemble spring clamp, clamp insulator, flat washer, lock washer and nut on stud. Do not tighten at this time.

2. Place a short piece of 2 x 4 between lower end of spring and axle housing. See Figure 7-24. This assembly aid holds the spring forward on the lower control arm to facilitate attachment of the spring to the lower control arm.

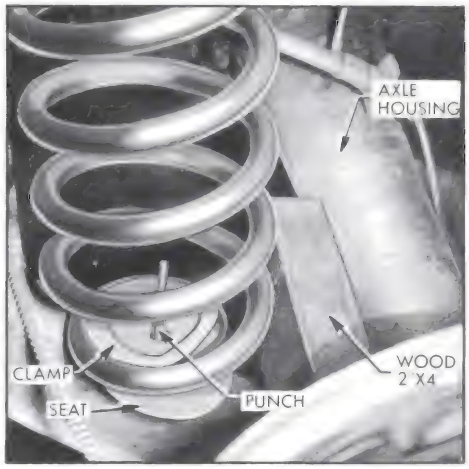


Figure 7-24—Wood Block Behind Rear Spring

3. Raise control arm to contact spring and slip spring between spring and control arm.

4. Insert a long tapered punch through the control arm bolt hole from the bottom to maintain alignment of the control arm and spring seat hole.

5. Slip spring clamp over punch and position straight side of clamp along straight end of spring.

6. Rotate spring if necessary to locate spring end at top as follows:

Left - top spring end towards rear of car

Right - top spring end towards front of car

Tighten upper spring clamp nut to 18 ft. lbs.

7. Raise control arm until lower spring clamp bolt can be installed. Torque lower spring clamp nut to 25 ft. lbs.

Install lower control arm to bracket on rear axle, install bolt, washer and nut and torque nut to 75 ft. lbs.

8. Reattach shock absorber to axle bracket and remove short piece of 2 x 4 behind spring. Torque lower shock attaching nut to a minimum of 35 ft. lbs.

9. Carefully attach the propeller shaft to the rear companion flange observing the following precautions:

a. Compress the bearing cups using a 4" C-clamp to assure that the snap rings do not gouge the companion flange when seating.

b. Do not use the U-bolts to draw the bearing cups into place. U-bolts should be seated and the nuts drawn up evenly.

Use Torque Wrench Adapter J-9113 to torque U-bolt nuts to 13 ft. lbs.

10. Reinstall brake line bracket to rear suspension cross member bolt.

11. Remove car stands and lower car.

d. Use of Special Overload Rear Coil Springs

Special 200 or 500 pound overload rear coil springs are available for service installation in cases where heavy loads are carried or heavy trailers are towed. Overloading any series rear axle in excess of 500 pounds is not recommended.

In estimating rear spring overloads, place rear wheels of car on scale, with car at curb weight and no load in rear compartment other than spare wheel and tire. After obtaining weight, hook trailer to car, or place desired load in rear compartment, and read scale again. The additional weight is the amount of overload on springs and rear axle.

Trailer design, and distance that trailer coupling is located to rear of rear axle center line, are the

major factors governing effective trailer overload. Instructions for attaching trailers to Buick cars may be obtained from Buick Motor Division, Service Department.

7-14 REMOVAL AND INSTALLATION OF BRAKE REACTION ROD

Removal

1. Raise front of car.

2. Remove the cotter pin in the brake reaction rod, then remove the castellated nut and washer.

3. Remove the control arm to frame compression bumper by removing two bolts in the compression bumper, then remove the brake reaction rod by sliding it out of its rubber bushing on the frame front cross member.

Installation

1. Remove and replace old rubber bushing if worn.

2. Install washer with larger diameter on brake reaction rod first, with concave side away from nut. Install rod thru bushing in frame bracket. Install washer with smaller diameter and castellated nut. Do not tighten.

3. Install frame compression bumper over brake reaction rod and install two bolts and washers. Torque to 90 ft. lbs.; this is very important as the brake reaction rod is an integral part of the lower control arm assembly and any looseness can cause detrimental car handling characteristics.

4 Torque castellated nut on brake reaction rod to 70 ft. lbs. Install cotter pin in hole of brake reaction rod.

NOTE: CASTER AND CAMBER MUST BE CHECKED AFTER REPLACEMENT OF BRAKE REACTION ROD.

NOTE: If there is any question concerning the serviceability of the brake reaction rod to lower control arm bolts, nuts or washers, install Group 6.171, Part #1389760 Package, which includes two special bolts, two special nuts and four special washers. Never use standard bolts, nuts or washers at this location.

7-15 REPLACE OR REBUSH FRONT LOWER CONTROL ARM ASSEMBLY

If a lower control arm is bent or broken it should be replaced. Consult the Buick Parts Book for the parts or assemblies required. Proceed as follows:

Removal

1. Follow Steps 1 thru 9 on front coil spring removal, Section 7-13, subparagraph b.

2. Remove cotter pin from bolt of lower control arm. Now remove castellated nut and bolt. Remove lower control arm.

3. If lower control arm bushing is to be removed it may be pushed or driven from the frame using a suitable tool.

Installation

1. New lower control arm bushing should be driven into hole in frame until it bottoms against frame.

2. Slip lower control arm over bushing and install bolt and castellated nut. Torque nut to 100 ft. lbs. and install cotter pin. Do not back off nut to align hole in bolt for cotter pin installation. Bend tabs of cotter pin.

3. Follow Steps 1 thru 14 on replacement of front coil springs, Section 7-13, subparagraph b.

7-16 REAR SUSPENSION SERVICE PROCEDURES

a. Removal and Installation of Lower Control Arm

Removal

1. Follow Steps 1 thru 7 for removal of the rear springs, Section 7-13, subparagraph c. Spring need only be disconnected at the lower seat.

2. With the bottom of the spring positioned off of the control arm and towards the differential carrier, raise rear axle assembly to permit reconnecting shock absorber to lower bracket. This is done to help maintain position of

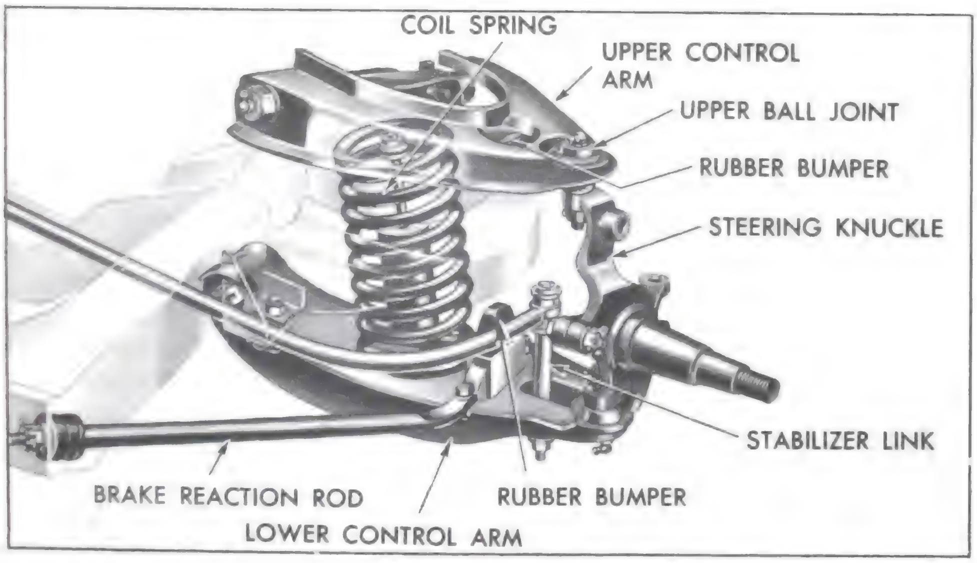


Figure 7-25—Front Suspension

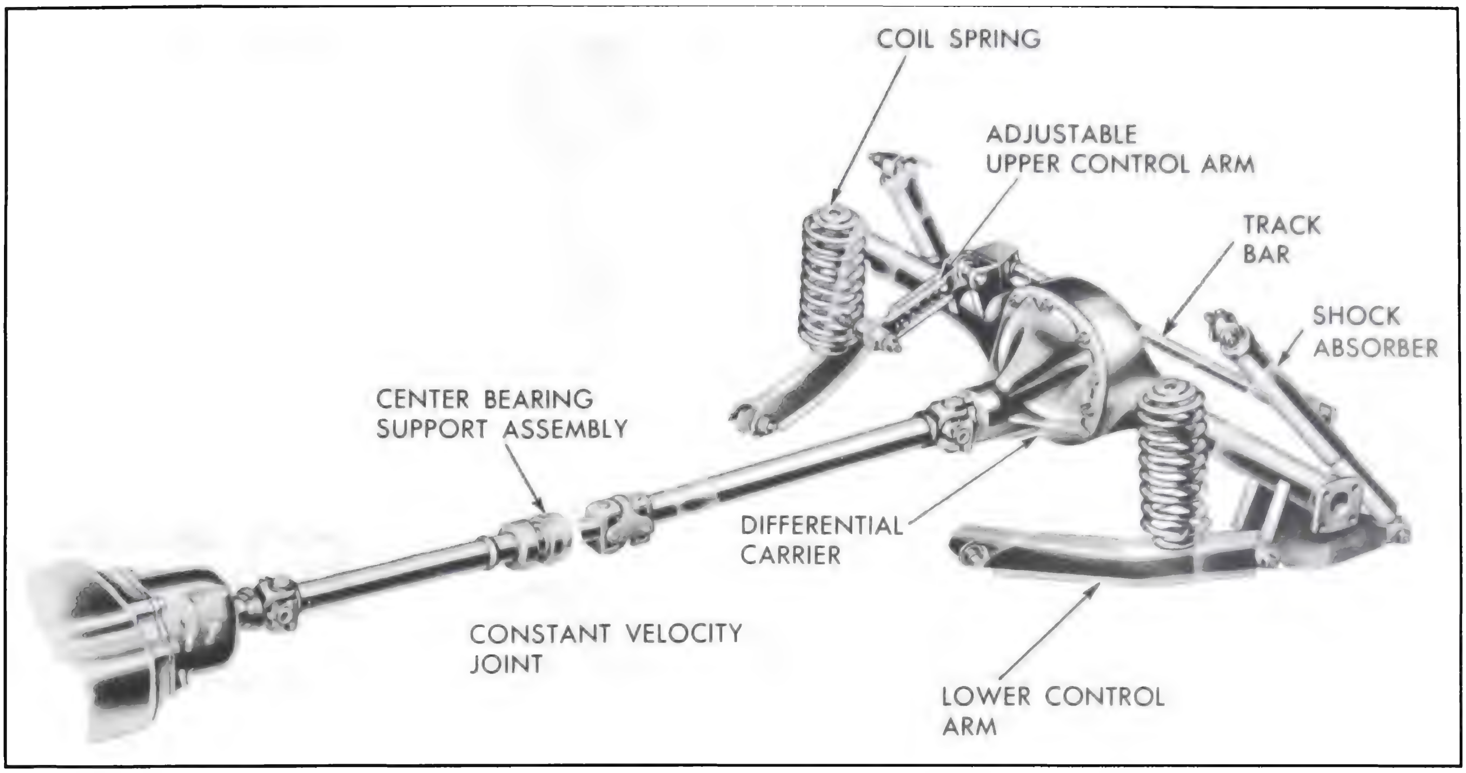


Figure 7-26—Rear Suspension

rear axle assembly so as to reduce binding of lower control arm and thus facilitate removal.

3. With housing still supported, remove lower control arm rear bracket bolt. If some difficulty is encountered in removing bolt, reposition jack farther forward under nose of carrier and slowly raise to relieve pressure and bind at control arm bushing. It may be necessary to use suitable brass drift to tap out bolt.

4. Remove lower control arm front bracket nut and bolt. After nut is removed it may be necessary to tap out bolt with brass drift. Remove lower control arm.

Installation

1. Before installing control arm, check front edges of control arm brackets and remove burrs as necessary. Check all bolts, replace as necessary.

2. Position control arm in front bracket and install bolt, lock washer and nut. Do not tighten.

3. Slowly raise rear axle assembly until control arm rear bushing is aligned with bracket bolt hole. It may be necessary to line up bolt holes with a tapered punch to permit installation of bolt, lock washer and nut. Do not tighten.

4. Disconnect shock absorber at lower end. Lower rear axle assembly to allow positioning of spring in its seat on the lower control arm. Place a short piece of 2 x 4 between the lower end of the spring and axle housing. See Figure 7-24. This assembly aid holds the spring forward on the lower control arm to facilitate attachment of the spring to the lower control arm.

5. Insert spring seat between spring and control arm. Insert a long tapered punch through the control arm bolt hole from the bottom to maintain alignment of the control arm and spring seat hole.

6. Slip spring clamp over punch and position straight side of clamp along straight end of spring.

7. Spring should be at frame top as follows:

Left - top spring end towards rear of car

Right - top spring end towards front of car

If springs are not positioned in this manner loosen top spring clamp bolts, reposition springs, and retorque spring clamp bolts to 17 ft. lbs. Hold spring in position, and with lower spring clamp plate correctly positioned, install bolt with nut on bottom and torque to 25 ft. lbs.

8. Raise rear axle assembly to reconnect shock absorber at lower bracket. Remove short piece of 2 x 4 behind spring.

9. Tighten shock absorber bolt to a minimum of 35 ft. lbs. and tighten control arm bushing bolts to 75 ft. lbs.

NOTE: Car should be in normal load position when tightening shock absorbers and lower control arms. Thus where possible car should be supported by wheel

hoist, by axle contact hoist, or on wheel stands. If this is impossible due to equipment on hand, simulating normal load height with jack under rear axle housing could be done.

10. Carefully attach the propeller shaft to the rear companion flange observing the following precautions:

a. Compress the bearing cups using a 4" C-clamp to assure that the snap rings do not gouge the companion flange when seating. See Figure 6-70.

b. Do not use the U-bolts to draw the bearing cups into place. U-bolts should be seated and the nuts drawn up evenly.

11. Use Torque Wrench Adapter J-9113 to torque U-bolts nuts to 13 ft. lbs.

12. Reinstall brake line bracket to rear suspension cross member.

13. Remove car stands and lower car.

b. Track Bar Service and Replacement

Removal

1. Raise car and support axle housing so weight of car will be on rear springs.

2. Remove pivot bolt and nut attaching track bar to bracket on axle housing.

3. Remove pivot bolt and nut attaching track bar to track bar bracket on left side of car.

4. Track bar can now be removed from brackets.

5. If track bar bracket is to be removed, remove three bolts, washers, and nuts attaching track bar bracket to frame side rails and remove track bar bracket. See Figure 7-28.

Inspection

1. If track bar is bent it should be replaced. No attempt should be made to straighten it.

Figure 7-27—Track Bar-Axle Attachment

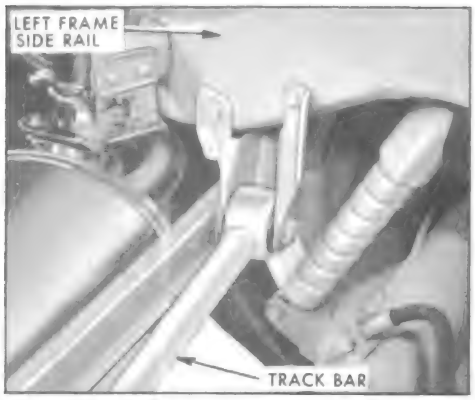


Figure 7-28—Track Bar-Frame Attachment

2. Check rubber bushings for evidence of deterioration, tears, etc. Examine center steel sleeve for excessive wear or separation from rubber.

Removal and Replacement

1. Press out old bushing from side which has no flange using a ram 1 7/8" O.D. Considerable force may be required to remove the bushing.

2. Install new bushing in track bar eye by pressing on flanged side of bushing. Press in bushing until flange is in contact with eye of track bar.

Installation

NOTE: Track bar to bracket bolts must not be tightened unless car is at normal trim height.

1. If track bar bracket was removed install three bolts, washers, and nuts to attach track bar bracket to frame side rails. Torque to 60 ft. lbs.

2. Install pivot bolt and nut attaching track bar to track bar bracket on left side of car. Do not tighten.

3. Install pivot bolt and nut attaching track bar to bracket on axle housing. Torque nut to 120 ft. lbs.

4. Torque track bar nut on left side of car to 120 ft. lbs.

7-17 SHOCK ABSORBER SERVICE AND REPLACEMENT

a. Checking Shock Absorbers

Both front and rear shock absorbers are filled and sealed in production and cannot be refilled in service.

b. Removal and Installation of Front Shock Absorber

1. Remove upper mounting stem nut, grommet retainer and grommet. A 1/4" flat on shock stem may be used to hold stem while removing nut.

2. Remove two lower mounting bracket to lower control arm bolts. Lower shock through lower control arm.

3. Make certain the shock absorber being installed is correct for car model as indicated by part number stamped on outer tube. See Master Parts List, Group 7.345.

4. Assemble lower grommet retainer and grommet on shock stem. Extend shock and install through lower control arm.

5. Install two shock bracket to lower control arm bolts and lock washers. Tighten to 20 ft. lbs.

6. Assemble top grommet, grommet retainer, and nut on stem.

c. Removal and Installation of Rear Shock Absorber

1. Raise rear of car.

2. Remove lower shock absorber mounting eye bolt and nut.

3. Remove upper shock absorber mounting nut, washer and bushing. Remove shock absorber.

4. Inspect all rubber bushings and grommets and replace if not in good condition. If shock absorber operation is faulty, it must be replaced as it cannot be repaired.

5. Make certain the new shock absorber is correct for car model as indicated by part number stamped on the outer tube. See Master Parts List, Group 7.345 for standard and optional parts.

6. Assemble bushing in upper shock eye. Place shock with bushing over stud in frame, install flat washer and nut. Torque nut to 40 ft. lbs.

7. Lower rear end of car. Then tighten pivot bolt to a minimum of 35 ft. lbs.

NOTE: Car weight must be on rear wheels when tightening shock absorber lower ends to clamp rubber bushings in a neutral position.

Shock absorber calibrations as furnished in production have been carefully engineered to provide the best ride control over a wide range of driving conditions. Substitution of other calibrations may adversely affect car performance and is not recommended by Buick Motor Division.

7-18 FRONT WHEEL ALIGNMENT

Wheel alignment is the mechanics of properly adjusting all the factors affecting the position of front wheels so as to cause the car to steer with the least effort and to reduce tire wear to a minimum.

Correct alignment of the frame is essential to proper alignment of front and rear wheels. Briefly, the essentials are that the frame must be square in plan view within specified limits, that the top and bottom surfaces of front cross member must be parallel fore and aft, and the bolt holes for support upper arms and lower control arm shafts must be of correct size and location. Checking frame alignment is covered in Group 12.

It should also be understood that wheel and tire balance has an important effect on steering and tire wear. If wheels and tires are out of balance, "shimmy" or "tramp" may develop or tires may wear unevenly, and give the erroneous impression that the wheels are not in proper alignment. For this reason, the wheel and tire assemblies should be known to be in proper balance before assuming that wheels are out of alignment.

Close limits on caster, front wheel camber, and theoretical king pin inclination are beneficial to car handling, but require only reasonable accuracy to provide normal tire life. With the type of front suspension used, the toe-in adjustment is much more important than caster and camber in so far as tire wear is concerned. Caster and camber adjustments need not be considered unless visual inspection shows these settings to be out, or unless the car gives poor handling on the road.

In the majority of cases, services consisting of inflating tires to specified pressure and interchanging tires at recommended intervals (par. 7-8) adjusting steering gear (par. 8-4 manual and par. 8-13 power), and setting toe-in correctly (subpar. e, below) will provide more improvement in car handling and tire wear than will front end alignment adjustments as usually made on front end of alignment equipment.

The use of accurate front end alignment equipment is essential to determine whether front suspension parts have been damaged by shock or accident, and to obtain correct alignment settings after new parts have been installed.

a. Design Considerations Affecting Caster, Camber and Toe Change

The caster angle of an independent front ball-joint suspension is

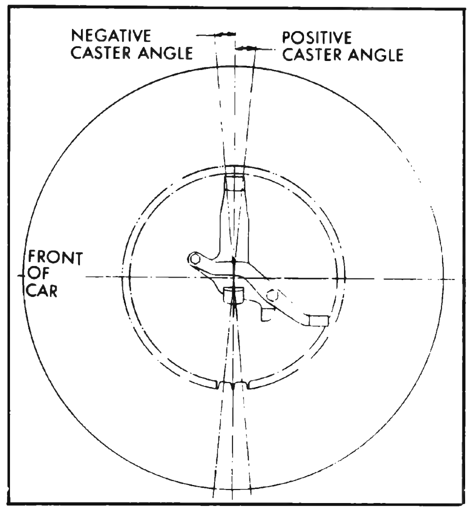


Figure 7-29—Caster Angle

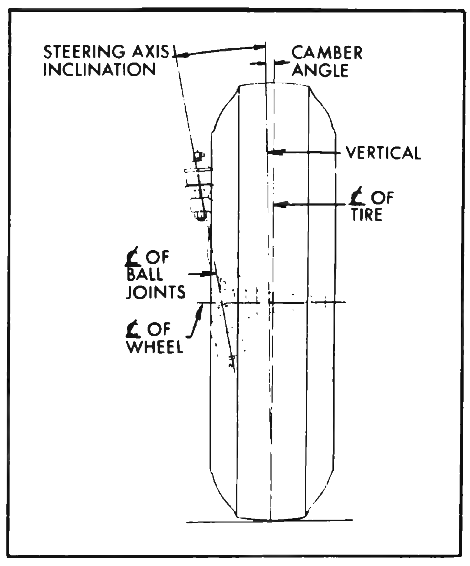


Figure 7-30—Camber Angle and Steering Axis Inclination

the angle made by a line passing through the center of the upper and lower ball joints, and a vertical line through the centerline of the spindle in relation to the ground, when looking at the side of a car. The angle is called "positive" if the upper ball joint is behind the lower, and "negative" if the upper ball is ahead of the lower. See Figure 7-29.

Once the caster has been set, the caster angle will change due to one or both of the following:

1. A change in trim height of the front suspension from the trim at which the caster was set.

2. A change in trim height of the rear suspension from the trim at which the caster was set.

The front suspension is attached to the front spring cross member of the frame. The caster is determined by the angle of the line through the upper and lower front suspension ball joints to the ground. Therefore, the angle of the frame to the ground also controls the caster angle.

Since the caster and camber are in relation to the ground it is necessary to have tires, spindles, wheel bearings, and other related parts correct before setting front-end alignment.

b. Inspection Before Checking Front Wheel Alignment

Before any attempt is made to check or make any adjustment affecting caster, camber, toe-in, theoretical king pin inclination, or steering geometry, the following checks and inspections must be made to insure correctness of alignment equipment readings and alignment adjustments.

1. The front tires should have approximately the same wear and all tires must be inflated to specified pressures (par. 1-2).

2. Check front wheel bearings for looseness and adjust, if necessary (par. 7-10).

3. Check for run-out of wheels and tires and correct to within limit of 1/8" run-out at side of tires, if necessary. (par. 7-7).

4. Check wheels and tires for balance and correct if out of balance (par. 7-8).

5. Check for looseness at ball joints and tie rod ends; if found excessive it must be corrected before alignment readings will have any value (par. 7-5).

6. Check shock absorber action and correct if necessary (par. 7-5).

7. Check trim height, if out of limits, correct with shims or replace spring. CAUTION: Consideration must be given the optional equipment on the car, undercoating, dirt, etc.

Good judgment should be exercised before replacing a spring when car trim height is only slightly out of limits. Spring replacement under conditions of excessive weight as mentioned above will accomplish little and must be accompanied by shimming to obtain saiisfactory results. 1/8" shims are available through Buick Parts warehouses under Group 7.425. Refer to paragraph 7-13.

8. Car must be on level surface. Install alignment height Tool J-8973-23 between frame and lower control arm at each front wheel as shown in Figure 7-31.

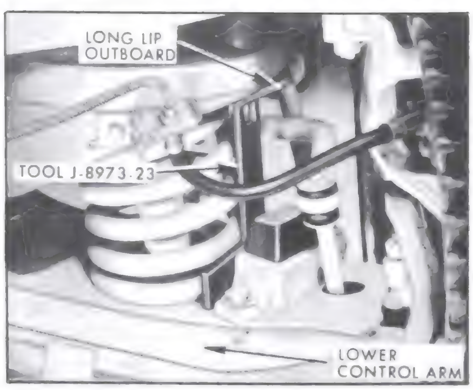


Figure 7-31—Front Alignment Height Tool in Place

Use Tool J-8973-19 in rear between frame and rear axle housing with top of spacer positioned over bolt at rear of bumper. See Figure 7-32. These tools are included in J-8973, Alignment Set.

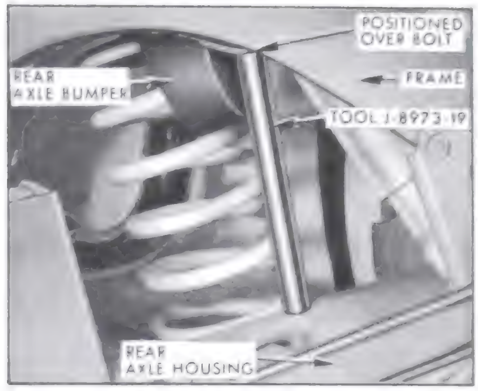


Figure 7-32—Rear Alignment Height Tool in Place

9. It is also advisable to check the condition and accuracy of any equipment being used to check front end alignment, and to make certain that instructions of the manufacturer are thoroughly understood.

c. Checking Caster and Camber Settings

Since caster and camber are both adjusted by shimming in the same locations, both of these settings must be checked before changing either setting.

CAUTION: Regardless of equipment used to check caster and camber, car must be on level surface both transversely and fore and aft. Since camber and caster vary in proportion to the height of the front springs, it is very important that the correct alignment height is maintained while checking (par. 7-18b).

Alignment height is used only when checking and adjusting caster and camber and should not be confused with trim height which is used to establish proper spring dimensions.

THE USE OF HEIGHT TOOLS IS NECESSARY TO MAINTAIN CASTER AND CAMBER AT THE SPECIFIED DESIGN POSITION. IF HEIGHT TOOLS ARE NOT USED, THIS DEFINITE POSITION WILL VARY ACCORDING TO THE CONDITION OF THE CAR. Undercoating, dirt and optional equipment will cause this position to vary. (It is not unusual to find 300 lbs. of dirt on a car).

When equipment is used which bears against the tire or wheel rim to obtain readings, it is very essential that the tires or wheels be checked for run-out. Readings must be taken at points which have no run-out or which lie in the same plane.

Caster and camber should be within the limits shown in Figure 7-34. Note that the caster angles at both front wheels need not be exactly the same but must be within 3/4 degrees of each other. Likewise, the camber angles on both sides must be within 3/4 degrees of each other. If caster and camber are not within the specified limits, adjust as described below.

d. Adjustment of Caster and Camber

Caster and camber may be adjusted by shimming at the upper control arm shaft attaching points. See Figure 7-33.

Production adjustment is done at the upper shaft locations using shims of .060", .080" and .100". The .080" shims are copper-plated for identification. The shims are horseshoe-shaped and at least one is used in each of the four upper locations. The shims are listed under Group 6.178 of the Master Parts List.

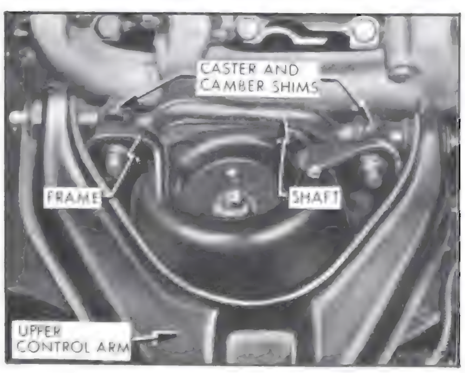


Figure 7-33—Upper Control Arm Shims

Addition or removal of upper control arm shims will change caster and camber settings. Due to the design of the upper control arm, changing shim patterns will affect both caster and camber at same time. Thus care should be taken to watch both settings when changing one or the other.

To shim at the upper control arm shaft location, it is necessary to wedge the bolt heads to prevent turning, and loosen both front and rear nuts to free the shims for removal or addition. The nuts are accessible from under the car through the use of a standard 7/8" socket, 5" extension. A suitable 13/16" box or open-end wrench may be used to hold the head of the bolt.

To permit maximum accessibility to the nuts, raise the front of the car at the center of the front suspension cross member until both wheels are free. Suitably support the car on car stands. Raising the car in this manner will allow both upper control arms to come to the extreme downward position, exposing nuts.

After installing or removing upper shims (limit .500" in any one stack) tighten and torque upper shaft bolts and recheck alignment. Correct toe-in if necessary. It is imperative to adhere strictly to the torque specifications given in paragraph 7-1.

If customer driving habits require driving on heavily crowded roads and a resultant wandering condition becomes a complaint, camber can be set at the high limit on the left wheel whenever front end alignment is being performed.

A Guide to Caster - Camber Correction 1964 - 4400 - 4600 - 4700 - 4800 Series

1. To Increase Camber Only - (More Positive)

Remove an equal amount of shims at front and rear bolt.

2. To Decrease Camber Only - (Less Positive)

Add an equal amount of shims at front and rear bolt.

3. To Increase Caster Only - (More Negative)

Increase the amount of shims at the front bolt and decrease by an equal amount at the rear bolt.

4. To Decrease Caster Only - (Less Negative)

Decrease the amount of shims at the front bolt and increase by an equal amount at the rear bolt.

5. To Increase Caster and Camber Simultaneously -

Remove shims at rear bolt only.

6. To Decrease Caster and Camber Simultaneously -

Add shims at rear bolt only.

e. Checking and Adjusting Toe-In

CAUTION: Car must be at curb weight and running height, (DO NOT USE ALIGNMENT HEIGHT TOOLS—bounce front end and allow it to settle to running height). Steering gear and front wheel bearings must be properly adjusted with no looseness at tie rod ends. The car should be moved forward one complete revolution of the wheels before the toe-in check and adjustment is started and the car should never be moved backward while making the check and adjustment.

1. Turn steering wheel to straight ahead position, with front wheels in straight ahead position.

2. Measure the horizontal distance from the near edge of front

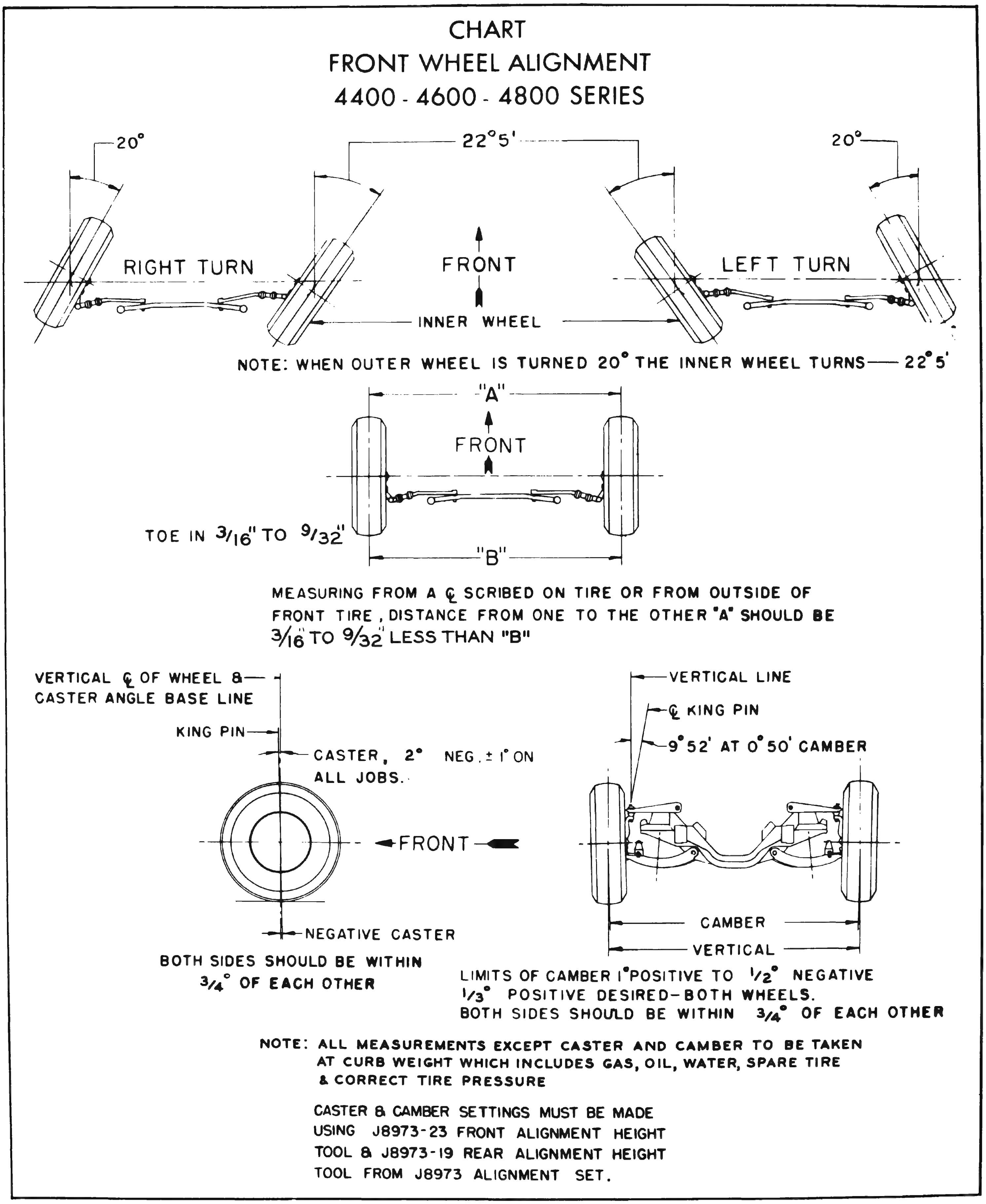


Figure 7-34—Alignment Specifications Chart

boss of lower control arm shaft to the front edge of brake backing plate, on each side. Adjust tie rods, if necessary, to make measurements equal on both sides.

3. Using a suitable toe-in gauge, measure the distance between outside walls of tires at the front at approximately 10" from the floor. See Figure 7-34 dimension "A". Mark points where gauge contacts tires. NOTE: An accurate check also can be made by raising and rotating front wheels to scribe a fine line near the center of each tire, then, with tires on the floor and front end at running height, measure between scribed lines with a suitable trammel.

4. Roll the car forward until measuring points on tires are approximately 10" from the floor at the rear, and measure the distance between points used in Step 3 above. The measurement at the front (dimension "A") should be 7/32" to 5/16" less than the measurement at the rear dimension "B"). See Figure 7-34.

5. If toe-in is not within specified limits, loosen clamp bolts and turn adjusting sleeves at tie rod ends as required. Decrease toe-in by turning left sleeve in same direction as wheel rotates moving forward and turn right sleeve in opposite direction. Increase toe-in by turning both sleeves in opposite direction.

CAUTION: Left and right adjusting sleeves must be turned exactly the same amount but in opposite directions when changing toe-in, in order to maintain front wheels in straight ahead position when steering wheel is in straight ahead position. The rod sleeve clamps must be positioned straight down to 45° to provide frame clearance.

6. After correct toe-in is secured tighten clamp bolts securely.

CAUTION: The steering knuckle and steering arm "rock" or tilt as front wheel rises and falls. Therefore, it is of vital importance to position the bottom face of tie rod end parallel with machined surface at outer end of steering arm. when tie rod length is adjusted. Severe damage and possible failure can result unless this precaution is observed.

f. Checking Steering Geometry (Turning Angles)

CAUTION: Be sure that caster, camber, and toe-in have all been properly corrected before checking steering geometry. Steering geometry must be checked with the weight of the car on the wheels.

1. With the front wheels resting on full floating turntables, turn wheels to the right until the outside (left) wheel is set at 20 degrees. The inside (right) wheel should then set at angle specified in Figure 7-34.

2. Repeat this test by turning front wheels to the left until the outside (right) wheel sets at 20 degrees; the inside (left) wheel should then set at angle specified in Figure 7-34.

3. Errors in steering geometry generally indicate bent steering arms, but may also be caused by other incorrect front end factors. If the error is caused by a bent steering arm it must be replaced. Replacement of such parts must be followed by a complete front end check as described above.

g. Checking Theoretical King Pin Inclination

CAUTION: When checking theoretical king pin inclination, car must be on a level surface, both transversely and fore and aft. It must be maintained at specified alignment height while checking (par. 7-18b).

With camber known to be within specified limits, theoretical king pin inclination should check within specified limits given in Figure 7-34.

If camber is incorrect beyond limits of adjustment and theoretical king pin inclination is correct, or nearly so, a bent steering knuckle is indicated.

If camber and theoretical king pin inclination are both incorrect by approximately the same amounts, a bent upper or lower control arm is indicated.

There is no adjustment for theoretical king pin inclination as this factor depends upon the accuracy of the front suspension parts. Distorted parts should be replaced with new parts. The practice of heating and bending front suspension parts to correct errors is not recommended as this may produce soft spots in the metal in which fatigue and breakage may develop in service.

Figure 7-35—Lower Ball Joint Tools

SECTION 7-C
SERVICE, ADJUSTMENT, AND REPLACEMENT PROCEDURES—CHASSIS SUSPENSION

CONTENTS OF SECTION 7-C

7-8 TIRE SERVICE AND INSPECTION

a. Tire Inflation and Inspection

Maintenance of correct inflation pressure in all tires is one of the most important elements of tire care. Correct tire pressure is also of great importance to ease of handling and riding comfort. Overinflation is detrimental to tire life but not so much as underinflation. Inflate all tires according to tire temperature as specified in paragraph 1-2.

Driving without valve caps contributes to underinflated tires. The valve cap keeps dirt and water out of the valve core and seals the valve against leakage. Whenever tires are inflated be sure to install valve caps and tighten firmly by hand. Make sure that rubber washer in cap is not damaged or missing.

If tires are checked at frequent intervals and adjusted to correct inflation pressure, it is often possible to detect punctures and make a correction before a tire goes flat, which may severely damage tire if car is in motion. Slight differences in pressure between tires will always be found, but a tire that is found to be 3 or more pounds below the lowest of its running mates can be suspected of having a leaking valve or a puncture.

All tires should be inspected regularly to avoid abnormal deterioration from preventable causes. If tires show abnormal or uneven wear the cause should be determined and correction should be made.

See that no metal or other foreign material is imbedded in the tread. Any such material should be removed to prevent damage to tread and tire carcass. Cuts in a tire which are deep enough to expose the cords will allow dirt and moisture to work into the carcass and ruin the tire unless promptly repaired.

b. Tubeless Tire Repairs

A leak in a tubeless tire may be located by inflating the tire to recommended pressure (par. 1-2) and then submerging tire and wheel assembly in water, or by applying water to tire with a hose if wheel is mounted on car. Remove water from area where air bubbles show and mark the area with crayon. After removal of the puncturing object from tire, the puncture must be sealed to prevent entrance of dirt and water which would cause damage to the tire carcass.

A small puncture of less than 3/32" diameter may be sealed without removal of tire from wheel by injecting sealing dough with a gun. Punctures up to 1/4" diameter may be sealed by installation of a rubber plug with cement, after tire has been removed from wheel. Sealing dough with gun, and rubber plugs with cement are contained in tire repair kits available through tire dealers. These materials should be used as directed in the instructions supplied with the kits. If a puncture is larger than 1/4" or there is other damage to the tire carcass, repairs should be made by authorized tire dealers in accordance with instructions of the tire manufacturer.

c. Wheel Leaks

Examine rim flanges for sharp dents. Any dent visible to the eye should be straightened. The rim flanges should be thoroughly cleaned with No. 3 coarse steel wool thereby removing all oxidized rubber, soap solution, etc. If the flange is rusted, it can be cleaned with a wire brush or in extreme cases of pitted rims a file can be used.

In isolated cases loss of air may result from loose rivets or porous welds. If the leak is minute and the rivet is not perceptibly loose, the leak can be sealed with a cement available from tire manufacturers for this purpose. If the rivet is noticeably loose or the air leak is large replace the wheel.

CAUTION: Under no condition should loose rivets or porous welds be brazed, welded or peened.

d. Demounting and Mounting of Tubeless Tire

When demounting a tubeless tire use care to avoid damaging the rim-seal ridges on tire beads. A "bead breaker" is recommended for loosening the beads. DO NOT USE TIRE IRONS TO FORCE BEADS AWAY FROM WHEEL RIM FLANGES. After both beads are broken loose from wheel rim flanges, remove tire in usual manner, starting at the valve stem, and using care to avoid damaging rim-seal ridges.

When tire is removed, inspect it carefully to determine whether loss of air was caused by puncture or by improper fit of beads against rim flanges. If improper fit is indicated, check wheel as follows:

(1) Straighten wheel rim flanges if bent or dented.

(2) Clean rims thoroughly, using No. 3 coarse steel wool, to remove all oxidized rubber, soap solution, etc. Remove rust with wire brush.

(3) Inspect butt weld and other areas of rim contacted by tire beads, to make certain there is no groove or high spot. Remove any groove or high spot by filing smooth.

(4) Inspect valve stem and replace it if damaged. Make certain that valve stem is properly installed to provide an air tight joint.

Before mounting a tubeless tire on a wheel remove cardboard spacer, if tire is new. Moisten a cloth with mounting compound or solution and wipe rim-seal ridges of both beads to remove all foreign substance. Moisten base of both beads with mounting compound or soap solution to help beads snap into place when tire is inflated. Start tire over rim frange at point opposite valve stem, so that valve stem cannot prevent bead from dropping into the well as last section of bead is forced over the rim flange. Align balance mark on tire with valve stem.

Either a tire mounting machine or tire irons may be used; however, parts of tools contacting tire beads must be smooth and clean to avoid damaging rim-seal ridges. Take small bites if tire irons are used. DO NOT USE HAMMERS.

CAUTION: Due to the violence with which the outer tire bead seats to the rim, it is recommended than an extension gauge with a clip-on check be used for mounting inflation. This will allow the operator to remain at a safe distance.

Remove valve core to increase flow of air during inflation. Hold tire and wheel assembly in vertical position and bounce on floor at various points around circumference to snap beads out against rim flanges. If seal cannot be effected in the foregoing manner with the rush of air, apply a tourniquet of heavy sash cord around circumference to tire and tighten it with a tire iron to force beads outward.

Inflate tire until both beads are firmly seated against rim flanges, then remove air chuck, insert valve core and temporarily inflate to 50 pounds pressure. Leak test wheel and tire assembly under water, and if satisfactory reduce to recommended pressure (par. 1-2).

e. Interchanging Tires

Tires tend to wear unevenly and become unbalanced as mileage accumulates. Uneven tire wear is frequently the cause of tire noises which are attributed to rear axle gears, bearings, etc., and work is sometimes needlessly done on rear axles in an endeavor to correct the noise.

Tire life will be increased and uneven wear and noise will be less likely to occur if the tires, including the spare, are balanced and interchanged at regular intervals of approximately 5000 miles. The recommended method of interchanging tires is shown in Figure 7-6.

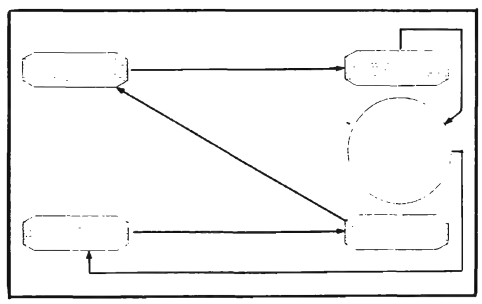


Figure 7-6—Method of Interchanging Tires

f. Use of Tire Chains

Do not use tire chains on the front wheels under any circumstances because they will interfere with the steering mechanism. Any of the conventional full-type non-skid tire chains can be used on the rear wheels.

Tire chains should be loose enough to "creep" but tight enough to avoid striking fenders or other parts. If chains remain in one position the tire side wall will be damaged. Tension springs (either metal coil springs or the rubber band type) must also be

used in order to prevent chains contacting frame, etc. The use of tension springs will also reduce ordinary chain noise caused by loose cross links contacting pavement.

g. Wheel and Tire Balance

Wheel and tire balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. Wheel unbalance is the principal cause of tramp and general car shake and roughness, and contributes somewhat to steering troubles.

All wheel and tire assemblies are statically balanced to within 6 inch ounces when assembled at the factory. After installation on the car, the complete assembly may be dynamically balanced if necessary or desired.

The original balance of the tire and wheel assembly may change as the tire wears. Severe acceleration, severe brake applications, fast cornering and side slip wear the tires out in spots and often upset the original balance condition and make it desirable to rebalance the tire and wheel as an assembly. Tire and wheel assemblies should be rebalanced after punctures are repaired.

Because of the speed at which cars are driven it is important to test the wheel and tire assembly for dynamic balance. Dynamic balancing of a wheel and tire assembly must be done on a machine designed to indicate out of balance conditions while the wheel is rotating. Since procedures differ with different machines, the instructions of the equipment manufacturer must be carefully followed.

In some cases wheel and tire balance does not always overcome wheel balance complaints because the brake drums themselves are out of balance. Balancing drums with wheels and tires as an assembly is not always satisfactory because the balance is destroyed when wheels and tires are removed or interchanged. On cars where trouble is experienced in maintaining proper wheel balance, it is suggested that all drums be individually checked for static balance and corrected, if necessary, as described under Brake Drum Balance (par. 9-12).

7-9 REPLACE STABILIZER LINK GROMMETS

The construction of the stabilizer links is shown in Figure 7-7. Neoprene grommets are used at the lower ends of the stabilizer links for grease resistance. This offers protection from chassis lube overflow from the lower ball joints.

The upper stabilizer grommets are rubber as they are out in the open where grease resistance is not required.

To disassemble, remove nut from lower end of the link rod, then remove rod, spacer, retainers, and grommets. When new, the link grommets are 7/8" free length. When assembling, install rubber grommets dry and use care to center the grommets in the seats on stabilizer shaft and lower control arm plate, also center the retainers on grommets before tightening rod nut. Tighten rod nut to 7 ft. lbs.

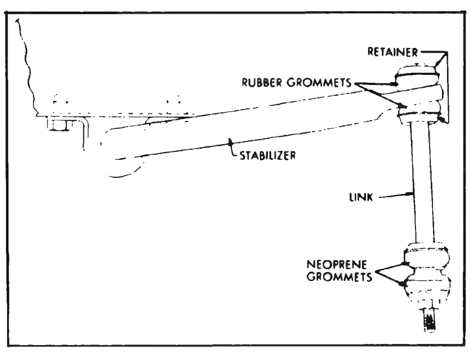


Figure 7-7—Front Stabilizer Link

7-10 REPLACE AND ADJUST FRONT WHEEL BEARINGS

a. Replacement of Bearings

1. Remove wheel with hub and drum assembly. Remove oil seal from hub so that inner bearing can be properly cleaned and inspected.

2. Wipe old grease out of hub and from steering knuckle spindle. Clean and inspect all bearing parts, and replace any that are faulty.

3. If a bearing cup outer race has to be replaced, drive the old cup out with a punch. Use care when installing the new cup to start it squarely into hub, to avoid distortion and possible cracking.

4. When inspecting or replacing bearing cones (inner races) make sure that cones are free to creep on spindle of steering knuckle. The cones are designed to creep on the spindle in order to afford a constantly changing load contact between the cones and the roller bearings. Polishing the spindle and applying bearing lubricant will permit creeping and prevent rust forming between cone and spindle.

5. Wash and thoroughly dry all bearing parts, because wheel bearing lubricant will not adhere to oily surfaces.

6. Thoroughly pack both bearing assemblies with new wheel bearing lubricant, preferably using a bearing packer. If packer is not available, work lubricant into bearings by hand. In either case, remove any surplus lubricant.

7. Apply a light coating of lubricant to spindle and inside surface of wheel hub to prevent rusting.

8. Place inner bearing assembly in cup and install a new oil seal, driving seal squarely into hub with Installer J-6541. Carefully install inner bearing cone in oil

seal. NOTE: Never place cone on spindle because seal will be damaged as wheel is installed.

9. Install wheel on spindle, then install outer bearing assembly, cone, safety washer and nut. See Figure 7-8.

10. Adjust bearings as follows (subpar. b).

b. Adjustment of Front Wheel Ball Bearings

1. Torque spindle nut to 19 ft. lbs. while rotating wheel.

2. Back off nut until bearings are loose.

3. Retighten nut to 11 ft. lbs. torque while rotating wheel.

4. If either cotter pin hole in spindle lines up with slot in nut, back off nut 1/12 turn and install cotter pin. 1/6 turn is maximum allowable back-up to align hole with slot.

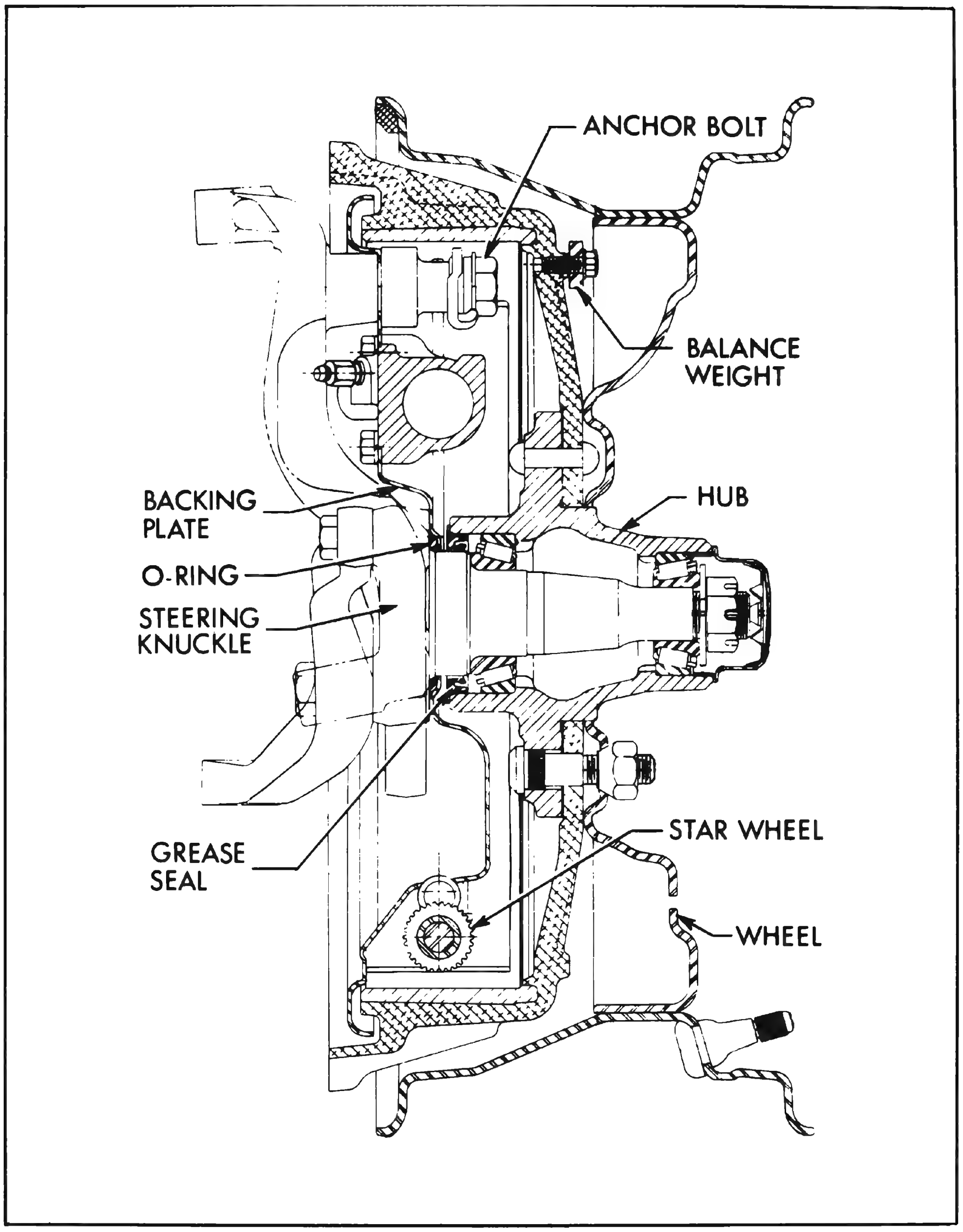


Figure 7-8—Front Wheel Hub and Bearings

7-11 REMOVAL AND INSTALLATION OF BALL JOINTS AND/ OR STEERING KNUCKLE

a. Removal and Installation of Upper Control Arm Ball Joint Assembly

The upper ball joint assembly is pressed into the upper control arm and is serviced only as a part of this upper control arm-ball joint assembly. The upper ball joint stud is spring loaded in its socket. If the upper stud has any perceptible shake, or if it can be twisted in its socket with the fingers, the upper control arm-ball joint assembly should be replaced. See Figure 7-9.

Removal

1. Raise car with jack under frame. Remove wheel and tire.

2. Remove cotter pin from castellated nut on upper ball joint tapered stud.

3. Loosen, but do not remove nut. Force of chassis spring will be tending to disengage ball joint tapered stud from steering knuckle. Rap knuckle sharply in area of tapered stud to disengage stud from knuckle. See Figure 7-19.

4. With another jack support car weight under outer edge of lower control arm and remove nut from ball joint tapered stud.

5. Now lower the jack placed under the lower control arm to slightly lower the knuckle, hub and drum assembly. Be careful to avoid damage to the brake hose.

6. Remove the upper control arm shaft to bracket nuts and lock washers, carefully noting the number, location, and thickness of adjusting shims between the shaft and frame bracket. Remove the control arm assembly.

7. Clamp the control arm assembly in a vise and remove the bushings, seals, and shaft. After cleaning away the old grease, examine the shaft and bushings for

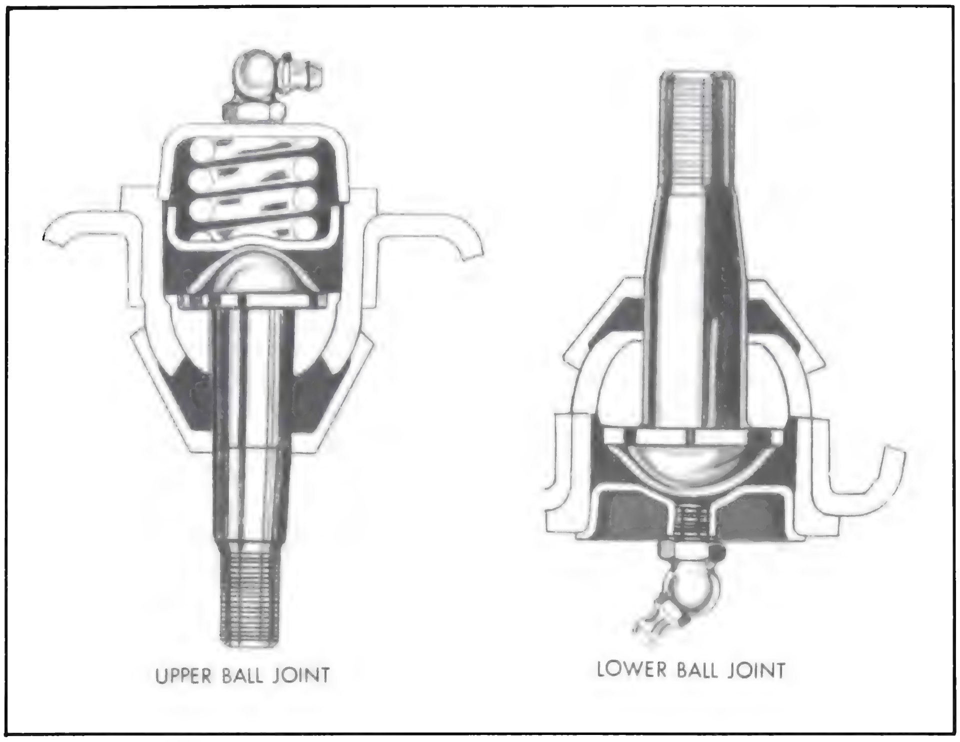


Figure 7-9—Upper and Lower Ball Joints

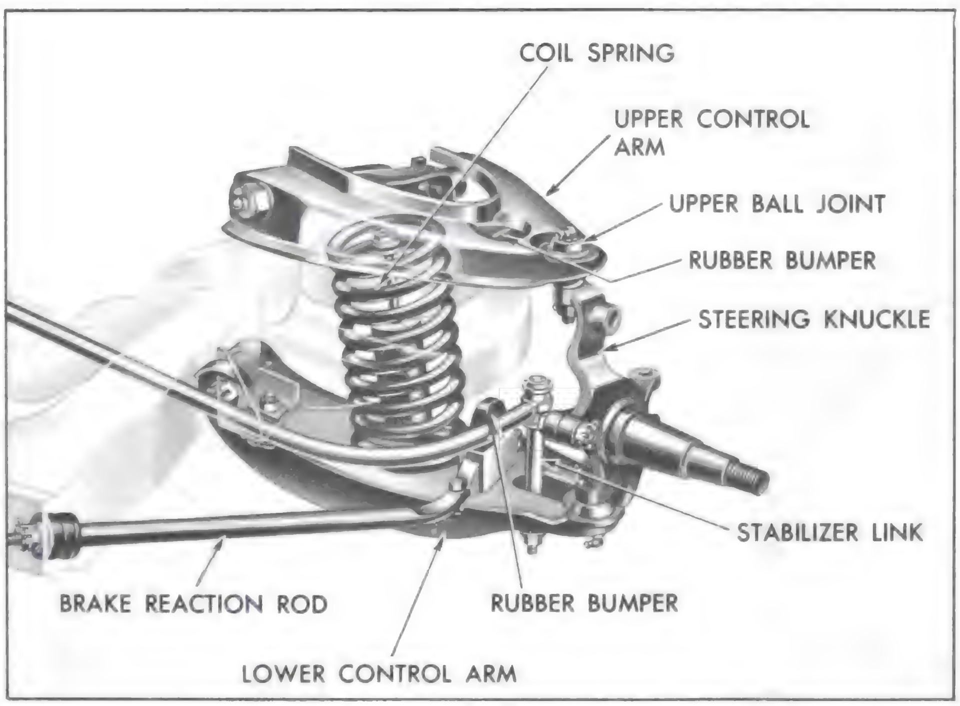


Figure 7-10--Front Suspension

excessive wear or damage. Replace any excessively worn parts.

Installation

1. Assemble new grease seals on the shaft. Apply a coating of good quality and long-effectiveness chassis lubricant to the shaft threads, and position the shaft in the new control arm-ball joint assembly.

2. Start bushing into upper control arm. Thread shaft into bushing to aid in alignment. Torque bushing to 70 ft. lbs. maximum.

3. Start second bushing into the upper control arm with shaft threaded into the opposite bushing. See Figure 7-11.

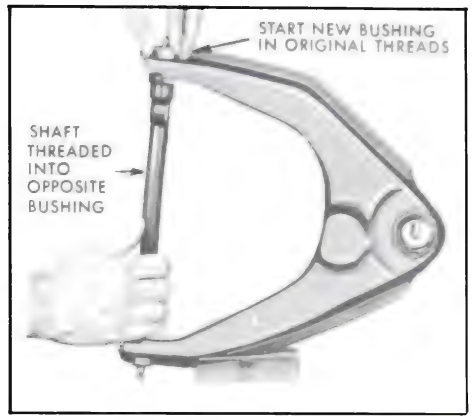


Figure 7-11—Upper Control Arm Bushing Replacement

4. After bushing has been threaded part way into arm, rotate shaft to engage threads of second bushing as an aid in piloting the bushing squarely into position.

5. Tighten bushing into arm until hex section of bushing seats firmly into arm. Torque to a minimum of 70 ft. lbs. Shaft should be free enough to turn by hand. Install grease fittings and lubricate bushings.

6. Rotate shaft to make distance between shaft bolt holes and arm equal both sides as nearly as possible. See Figure 7-12.

7. Assemble upper control arm and shaft assembly to bracket, making certain the number, thickness and location of adjusting shims between shaft and bracket are correct. Torque shaft to bracket nuts to 100 ft. lbs. The nuts may be torqued from with the engine compartment through the use of a standard 11/16"-1/2" drive socket and J-1313 Torque Wrench or its equivalent.

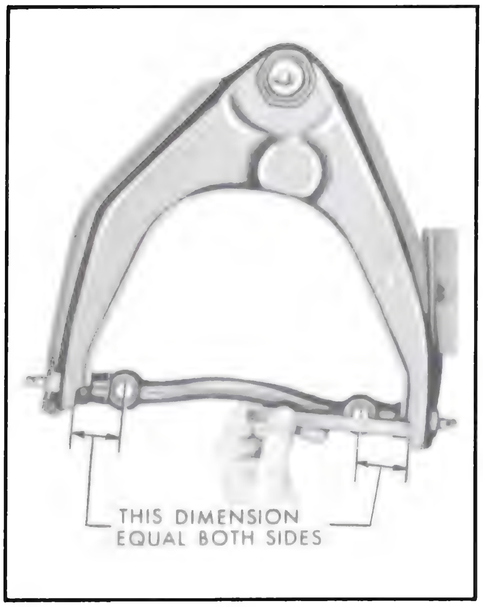


Figure 7-12—Upper Control Arm Shaft Position

8. Assemble tapered stud to knuckle with cotter pin holes fore and aft. Install castellated nut. Torque to 35 ft. lbs. and install cotter pin.

9. Install wheel. Check and adjust front end alignment if necessary.

When working in the area of the front upper control arm, make certain that the rubber water deflectors are securely attached in their original positions when the work is completed. If reasonable care is exercised in removing the fasteners for these rubber deflectors, they may be satisfactorily reused.

10. Lubricate the ball joint and upper control arm shaft bushings with a long-effectiveness grease equivalent to Buick Specification No. 742.

b. Lower Control Arm Ball Joint Assembly—Removal and Installation

The lower ball joint assembly is pressed into the lower control arm and is serviced separately. The lower ball joint is not spring equipped and depends upon car weight to load the ball. See Figure 7-9.

Before checking lower ball joints, the wheel bearing must be properly adjusted and the suspension must be freely suspended. The car should be supported at the frame rails on each side at the front end. DO NOT USE A JACK OR STANDS UNDER LOWER CONTROL ARMS. Place a dial indicator at the lower vertical edge of the wheel. With one hand at the top and the other at the bottom of the tire, moderately rock the wheel at the top and bottom. If more than 1/16" movement appears on the dial indicator the lower ball joint should be replaced.

Removal

1. Raise front of car and place jack stands under frame side rails. Remove wheel with hub and drum assembly.

2. Remove the brake backing plate. If the backing plate is wired carefully out of the way as shown in Figure 7-13, there will be no need to disconnect the brake hose.

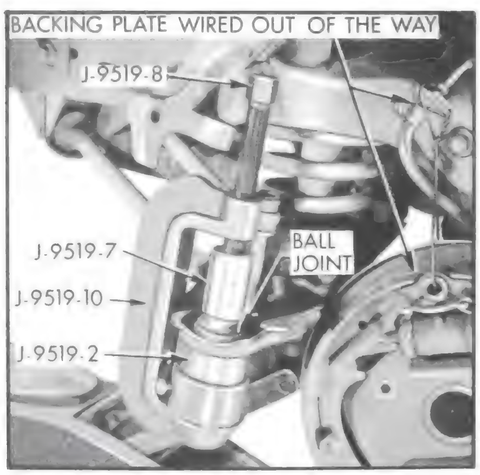


Figure 7-13—Lower Ball Joint Remover Tool in Place

3. For safety's sake place a floor jack under the lower control arm as far outboard on the arm as possible to gain maximum leverage advantage. Do not place the jack against the arm but about 1/2" below. Now remove cotter pin and loosen (do not remove) nut on lower ball joint tapered stud. Nut should be loosened not more than 1/8".

4. Rap the steering knuckle sharply in the area of the ball stud to allow the force of the chassis spring to disengage the tapered ball stud from the knuckle. NOTE: It is sometimes helpful to wedge a block of wood under the upper control arm to provide a solid stop so the lower ball stud can be loosened with a more solid hammer rap.

5. Place the jack under the lower control arm at the spring seat. Raise the jack until compression is relieved on the upper control arm rubber rebound bumper. Remove the stud nut. Move the steering knuckle out of the way.

6. Install Lower Ball Joint Remover and Installer J-9519 as shown in Figure 7-13. Note that the larger O.D. portion of Detail J-9519-2 is positioned in J-9519-10.

7. Tighten Detail J-9519-8 with a socket and handle as shown in Figure 7-14 until ball joint is forced out of the lower control arm. CAUTION: Ball joint may pop out suddenly.

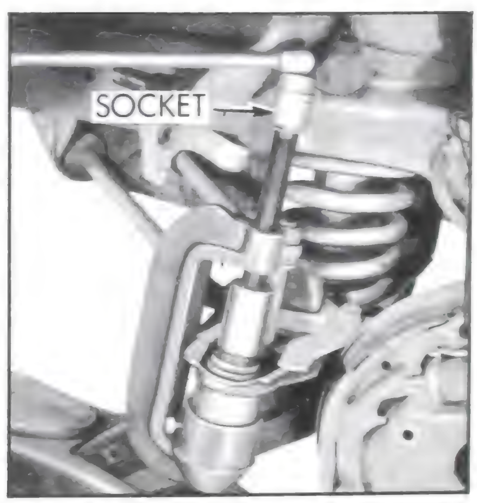


Figure 7-14—Removing Lower Ball Joint

Installation

1. Position ball joint minus dust shield in lower control arm and install Tool J-9519 as shown in Figure 7-15. Note that the larger O.D. portion of Tool Detail J-9519-2 is positioned in Detail J-9519-10.

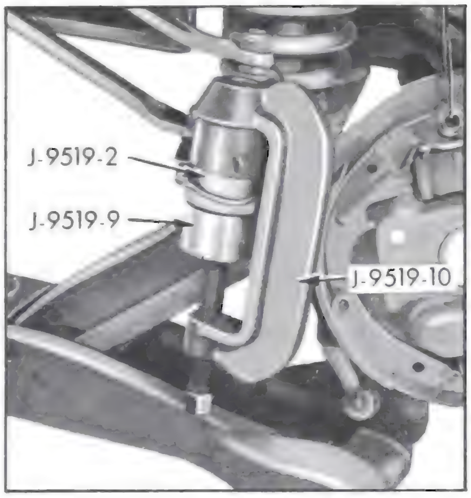


Figure 7-15—Lower Ball Joint Installer Tool in Place

2. With a suitable socket and handle force the ball joint into the lower control arm until it is fully seated. See Figure 7-16.

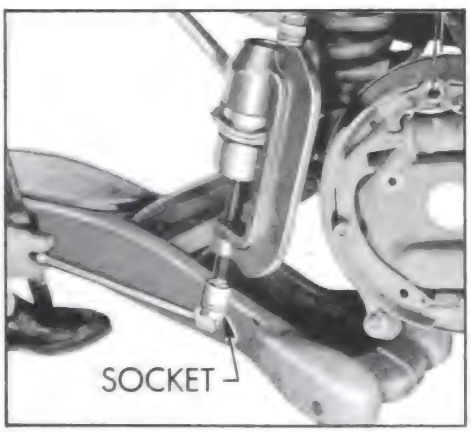


Figure 7-16—Installing Lower Ball Joint

3. Turn the stud so the cotter key hole is fore and aft, and assemble the rubber dust shield to the stud.

4. Position the tapered stud in the knuckle and install nut. Tighten the nut to 65 ft. lbs. and install cotter key.

5. Install wheel with hub and drum assembly. Adjust wheel bearings (par.7-10). Remove car stand and lower car.

NOTE: Upper and lower ball joints are similar in appearance but are not interchangeable.

c. Removal and Installation of Steering Knuckle

1. Follow Steps 1 thru 7 of subparagraph b., Removal of the Lower Ball Joint. Be certain to merely loosen the nut.

2. Remove cotter pin and loosen (Do Not Remove) nut on upper ball joint tapered stud. Nut should be loosened not more than 1/8".

3. Rap steering knuckle in area of stud on both upper and lower ball joints to separate studs from knuckle. Nuts that were previously loosened still hold upper and lower control arms to knuckle.

4. Making certain that the lower control arm is adequately supported by a jack on its outer extremities to prevent any downward travel of the lower control arm when removing ball joint nut, (it may be necessary to actually raise the lower control arm slightly to remove force of the knuckle against the nut) remove the nut and raise knuckle off tapered stud.

5. The upper ball joint is already loosened from the knuckle, and with no spring force to interfere, it is now possible to remove the nut from the tapered stud and thus remove the knuckle.

6. To replace knuckle, wipe stud of upper ball joint clean, assemble to knuckle with cotter pin hole fore and aft, seat with sharp blow of hammer, torque nut to 35 ft.lbs. and install cotter pin.

7. Wipe lower ball joint stud clean and assemble to knuckle as outlined in installation Steps 1 thru 5 subparagraph b, above.

7-12 REMOVAL AND INSTALLATION OF UPPER CONTROL ARM OR SHAFT

The removal and installation of the Upper Control Arm and Shaft is covered in paragraph 7-11 under a. Upper Control Arm-Ball Joint Assembly Removal and Installation.

7-13 CHASSIS SPRINGS

a. Checking Spring Trim Dimensions

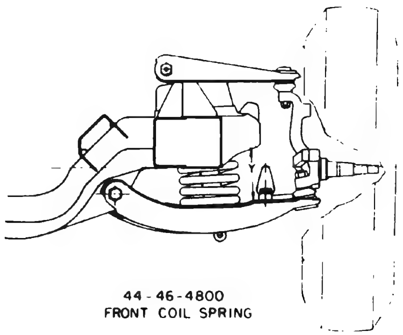
Optional equipment, undercoating, accumulated dirt, etc., changes the car weight and must be considered when checking spring trim dimensions. Because of the many possible variations in loading due to optional equipment it is not possible to give dimensions for all; therefore, the spring trim dimensions given below are for the standard car only, without optional equipment or undercoating and with car at curb weight. Curb weight includes gas, oil, water, and spare tire but no passengers.

Before measuring spring trim dimensions, bounce both ends of car up and down several times to make sure there is no bind in suspension members, and to let springs take a natural position. When car is at rest, measure the trim height at point "Y" for front spring or point "Z" for rear spring, as indicated in Figure 7-17.

(1) Front Springs. On a car having service miles the front spring trim-dimension "Y" should be as shown in Figure 7-17 chart.

NOTE: When checking NEW car add 1/4".

When the front spring trim dimension is found to be too low,



44 - 46 - 4800
FRONT COIL SPRING

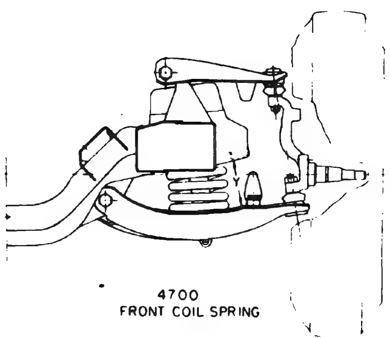
MODEL	FRONT COIL Y:18 CURB WEIGHT	FRONT COIL Y:18 NORMAL LOAD (DESIGN)	FRONT COIL Y:18 NORMAL LOAD (ACTUAL)	REAR COIL Z:24 CURB WEIGHT	REAR COIL Z:24 NORMAL LOAD (DESIGN)	REAR COIL Z:24 NORMAL LOAD (ACTUAL)
4411	5.23	4.52	4.36	7.25	6.04	5.34
4435	5.23	4.52	4.46	7.00	6.04	5.73
4439	5.23	4.52	4.36	7.25	6.04	5.34
4445	5.23	4.52	4.46	7.00	6.04	5.73
4447	5.23	4.52	4.36	7.25	6.04	5.34
4467	5.23	4.52	4.36	7.25	6.04	5.34
4469	5.23	4.52	4.36	7.25	6.04	5.34
4635	5.23	4.52	4.46	7.00	6.04	5.73
4639	5.23	4.52	4.36	7.25	6.04	5.34
4647	5.23	4.52	4.36	7.25	6.04	5.34
4667	5.23	4.52	4.36	7.25	6.04	5.34
4747	4.85	4.14	4.14	6.42	5.28	4.97
4819	5.23	4.52	4.39	7.25	6.14	5.53
4829	5.23	4.52	4.39	7.25	6.14	5.53
4839	5.23	4.52	4.39	7.25	6.14	5.53
4847	5.23	4.52	4.39	7.25	6.14	5.53
4867	5.23	4.52	4.39	7.25	6.14	5.53

CHASSIS TRIM DIMENSION 1963

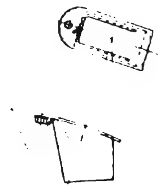
THESE DIMENSIONS DO NOT APPLY TO OPTIONAL SPRINGS

4400 4600 4800
NORMAL LOAD TRIM DIMENSIONS DETERMINED WITH 4 PASSENGER LOAD, 2 PASSENGERS IN FRONT SEAT, 2 PASSENGERS IN REAR SEAT.

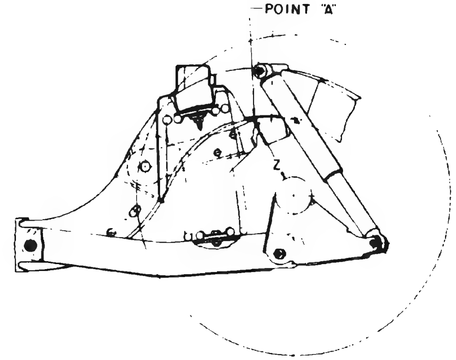
4700
NORMAL LOAD TRIM DIMENSIONS DETERMINED WITH 3 PASSENGER LOAD, 2 PASSENGERS IN FRONT SEAT, 1 PASSENGER IN REAR SEAT



4700
FRONT COIL SPRING



ENLARGED VIEW OF BUMPER



44 46 4800
REAR COIL SPRING

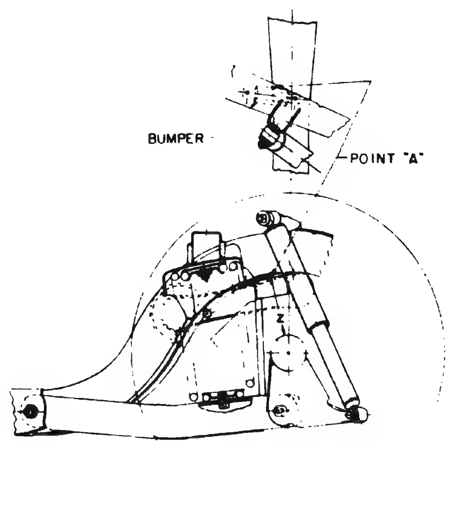


Figure 7-17—1964 Chassis Trim Dimensions

correction may be made by installing special shims (Group 7.425), 1/8" thick, between upper end of spring and the frame. If more than two shims are required, replace the spring.

(2) Rear Springs. On a car having service miles the rear spring trim dimension should be as shown on Figure 7-17 chart.

NOTE: When checking NEW car add 3/8".

If rear spring trim dimension is less than specified or additional height is required to prevent excessive "bottoming" in exceptional cases, install additional spring insulators (Group 7.545), divided between upper and lower ends of spring. If more than three additional insulators are required replace the spring. Installation of new springs should not increase trim dimension "A" more than 1" over specified maximum limit.

b. Front Coil Spring Removal and Installation

Removal

1. Raise front of car and support solidly with a car stand under the frame side rail on the side where the spring removal is to be performed. Car must be high enough to allow the lower control arm to be positioned nearly straight down with a jack placed beneath the ball stud end.

2. Remove wheel, brake drum and bearings. Take precautions against bearing damage from dirt, etc.

3. Remove the two bolts and nuts, and the anchor bolt holding the brake backing plate to the knuckle. Remove the backing plate but do not disconnect the brake hose. Support the backing plate in such a manner that the hose will not be damaged. Backing plate may be wired out of the way. See Figure 7-18.

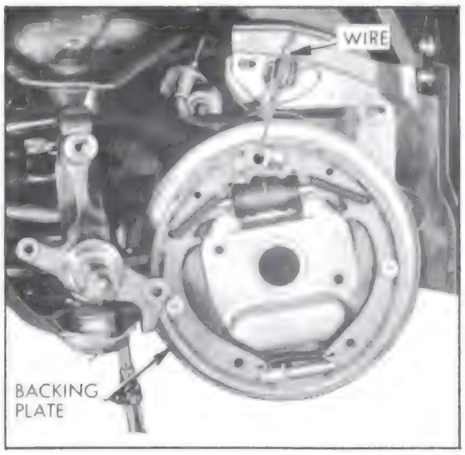


Figure 7-18—Wiring Brake Backing Plate Out of the Way

4. Remove the shock absorber. See paragraph 7-17.

5. Remove the front stabilizer rod link from the lower control arm. Place parts aside in their relative assembled position since the upper grommets are rubber while the lower ones are neoprene. They should be reassembled in this manner.

6. Disconnect the brake reaction rod and adjacent control arm bumper from the lower control arm but leave attached to the front frame cross member.

7. As a safety precaution place a floor jack under the lower control arm as far outboard on the arm as possible to gain maximum leverage advantage. It would be advantageous to remove the lube fitting at the lower ball joint so that it will not be damaged by the jack.

Do not place the jack against the arm, but about 1/2 inch below. Now remove the cotter pin and LOOSEN, DO NOT REMOVE the nut on the lower ball joint tapered stud. The nut should be loosened not more than 1/8".

8. Rap the steering knuckle in the area of the stud to separate the stud from the knuckle. See Figure 7-19. Raise the jack against the control arm to relieve pressure on the nut, remove the

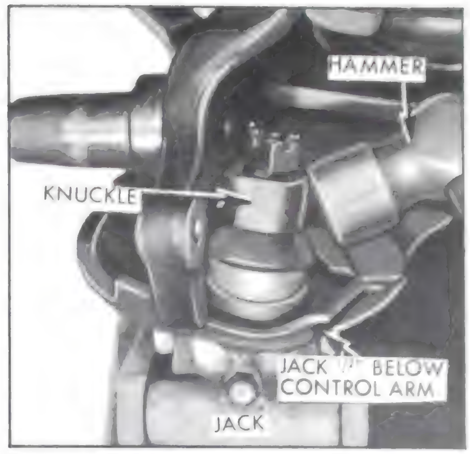


Figure 7-19—Separating Ball Stud From Knuckle

nut and separate the steering knuckle from the tapered stud.

9. Carefully lower the jack supporting the lower control arm to release the spring. With the jack all the way down to the floor it still may be necessary to pry the spring off its seat on the lower control arm with a long pry bar. See Figure 7-20. Caution should be exercised in handling this loaded spring while still attached.

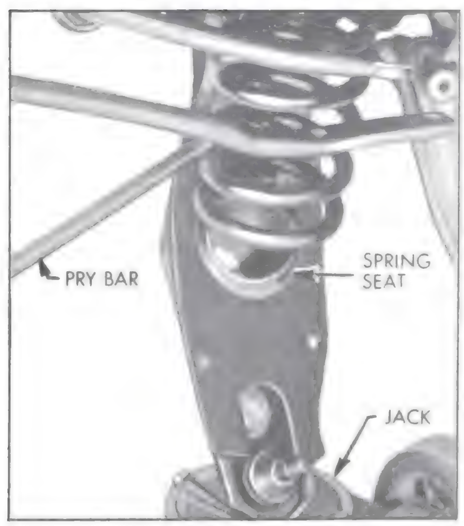


Figure 7-20—Prying Spring Off Its Seat

Installation

1. Position spring in frame upper spring seat. Align the lower end of the coil with the small hole in

Figure 7-21—Tool J-9552

the lower control arm. When assembled the end of the lower coil must be within 1/4" of this hole.

2. Place Plate J-7592-7 of spring installing Tool J-9552 between the 4th and 5th coil of the spring from the bottom. Step in plate will fit contour of the coil. Install bolt to plate and place threaded end of the bolt through the shock absorber hole in the frame spring seat.

3. Install special Nut J-9552-2 on the upper end of the bolts so that the shoulder of the nut protrudes through the hole in the upper spring seat to protect the threads of the bolt at this point.

4. Place a box wrench on the upper nut of the tool to keep it from turning. Now tighten the bolt with a 7/8" socket and extension. See Figure 7-22.

5. Tighten the bolt, compressing the spring, until at least 1-3/4" to 2" of the rod protrudes through the upper nut of the tool. At this point the spring is usually compressed sufficiently.

6. Force the spring on its seat in the lower control arm as shown in Figure 7-23. Remove tool.

7. With the spring in position raise the lower control arm with the jack and attach the lower ball joint tapered stud to the knuckle.

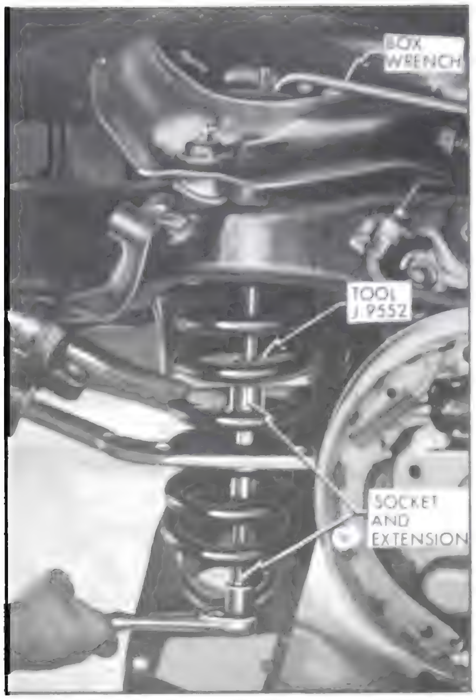


Figure 7-22—Compressing Front Spring With Tool J-9552

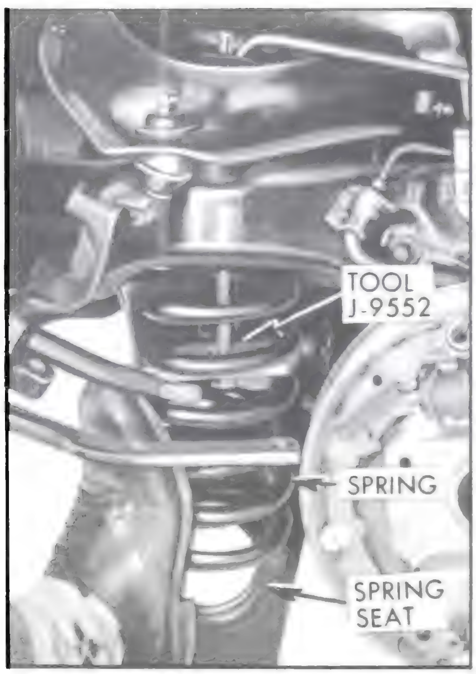


Figure 7-23—Pushing Spring on Lower Control Arm Seat

Make certain that the rubber dust cover is in place on the ball joint. Torque the nut to 70 ft. lbs. and install the cotter pin.

8. Install shock absorber. Torque upper nut to 10 ft. lbs., and lower bolts to 20 ft. lbs.

9. Attach brake reaction rod and compression bumper to the lower control arm. Torque the nuts to 90 ft. lbs.

NOTE: Never use standard bolts, nuts or washers at this location. If replacement parts are needed package, Group 6.171, Part 1389760, contains the two special nuts and four special washers necessary for this installation.

10. Reinstall stabilizer link and grommets. Assemble in same relative position as maintained after removal so that rubber grommets are on the stabilizer end while the neoprene grommets are at the lower control arm end of the link. See Figure 7-7.

11. Reinstall backing plate to knuckle making certain that "O" ring is in place on the spindle. Tighten front steering arm bolt nut to 45 ft. lbs.,rear bolt nut to 70 ft. lbs. and anchor bolt to 140 ft. lbs.

12. Wipe any accumulated dirt off the spindle and lightly lube with wheel bearing lubricant. Install outer roller bearing and special washer.

13. Install spindle castellated nut.

a. Torque spindle nut to 19 ft. lbs. while rotating wheel.

b. Back off nut until bearings are loose.

c. Retighten nut to 11 ft. lbs. torque while rotating wheel.

d. Back off nut at least 1/12 turn but not more than 1/6 turn, and install cotter pin. Bend ends of cotter pin so they do not interfere with the static collector in the dust cap.

14. Reinstall the lower ball joint grease fitting. Remove the car stand and recheck and adjust toe-in as necessary.

c. Rear Coil Spring Removal and Installation

Removal

1. Raise rear end of car and support on frame stands.

2. Mark universal joint and pinion companion flange for correct re-installation. This maintains the balance between these two parts as installed during original assembly. Disconnect by removing U-bolt clamps at pinion flange.

3. Slide propeller shaft forward on slip spline far enough to clear rear companion flange. Wire or otherwise suitably support propeller shaft up out of the way to prevent damage to constant velocity universal joint center ball by allowing it to bend to the end of its travel.

4. Remove bolt attaching brake line bracket to rear suspension cross member to provide slack in brake line.

5. Position jack under control arm below axle housing and raise jack slightly to relieve tension on shock absorber.

6. Disconnect shock absorber at axle bracket by removing nut and bolt.

7. Remove nut from lower spring clamp bolt and carefully lower jack to fully extend spring and remove bolt and spring clamp from lower control arm. Upper spring clamp can now be removed.

CAUTION: Do not completely lower jack as this will cause strain on brake hose.

Installation

1. Assembly upper insulators on stud between frame and top of spring. Position top of spring up against insulator and assemble spring clamp, clamp insulator, flat washer, lock washer and nut on stud. Do not tighten at this time.

2. Place a short piece of 2 x 4 between lower end of spring and axle housing. See Figure 7-24. This assembly aid holds the spring forward on the lower control arm to facilitate attachment of the spring to the lower control arm.

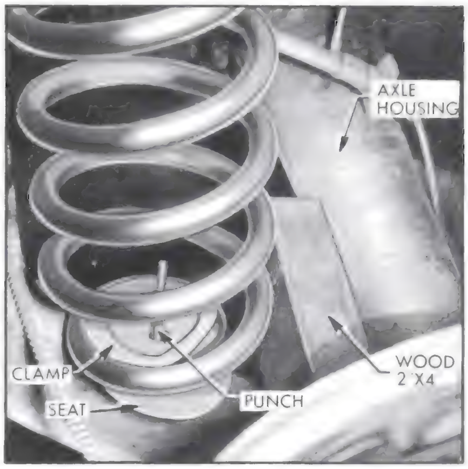


Figure 7-24—Wood Block Behind Rear Spring

3. Raise control arm to contact spring and slip spring between spring and control arm.

4. Insert a long tapered punch through the control arm bolt hole from the bottom to maintain alignment of the control arm and spring seat hole.

5. Slip spring clamp over punch and position straight side of clamp along straight end of spring.

6. Rotate spring if necessary to locate spring end at top as follows:

Left - top spring end towards rear of car

Right - top spring end towards front of car

Tighten upper spring clamp nut to 18 ft. lbs.

7. Raise control arm until lower spring clamp bolt can be installed. Torque lower spring clamp nut to 25 ft. lbs.

Install lower control arm to bracket on rear axle, install bolt, washer and nut and torque nut to 75 ft. lbs.

8. Reattach shock absorber to axle bracket and remove short piece of 2 x 4 behind spring. Torque lower shock attaching nut to a minimum of 35 ft. lbs.

9. Carefully attach the propeller shaft to the rear companion flange observing the following precautions:

a. Compress the bearing cups using a 4" C-clamp to assure that the snap rings do not gouge the companion flange when seating.

b. Do not use the U-bolts to draw the bearing cups into place. U-bolts should be seated and the nuts drawn up evenly.

Use Torque Wrench Adapter J-9113 to torque U-bolt nuts to 13 ft. lbs.

10. Reinstall brake line bracket to rear suspension cross member bolt.

11. Remove car stands and lower car.

d. Use of Special Overload Rear Coil Springs

Special 200 or 500 pound overload rear coil springs are available for service installation in cases where heavy loads are carried or heavy trailers are towed. Overloading any series rear axle in excess of 500 pounds is not recommended.

In estimating rear spring overloads, place rear wheels of car on scale, with car at curb weight and no load in rear compartment other than spare wheel and tire. After obtaining weight, hook trailer to car, or place desired load in rear compartment, and read scale again. The additional weight is the amount of overload on springs and rear axle.

Trailer design, and distance that trailer coupling is located to rear of rear axle center line, are the

major factors governing effective trailer overload. Instructions for attaching trailers to Buick cars may be obtained from Buick Motor Division, Service Department.

7-14 REMOVAL AND INSTALLATION OF BRAKE REACTION ROD

Removal

1. Raise front of car.

2. Remove the cotter pin in the brake reaction rod, then remove the castellated nut and washer.

3. Remove the control arm to frame compression bumper by removing two bolts in the compression bumper, then remove the brake reaction rod by sliding it out of its rubber bushing on the frame front cross member.

Installation

1. Remove and replace old rubber bushing if worn.

2. Install washer with larger diameter on brake reaction rod first, with concave side away from nut. Install rod thru bushing in frame bracket. Install washer with smaller diameter and castellated nut. Do not tighten.

3. Install frame compression bumper over brake reaction rod and install two bolts and washers. Torque to 90 ft. lbs.; this is very important as the brake reaction rod is an integral part of the lower control arm assembly and any looseness can cause detrimental car handling characteristics.

4 Torque castellated nut on brake reaction rod to 70 ft. lbs. Install cotter pin in hole of brake reaction rod.

NOTE: CASTER AND CAMBER MUST BE CHECKED AFTER REPLACEMENT OF BRAKE REACTION ROD.

NOTE: If there is any question concerning the serviceability of the brake reaction rod to lower control arm bolts, nuts or washers, install Group 6.171, Part #1389760 Package, which includes two special bolts, two special nuts and four special washers. Never use standard bolts, nuts or washers at this location.

7-15 REPLACE OR REBUSH FRONT LOWER CONTROL ARM ASSEMBLY

If a lower control arm is bent or broken it should be replaced. Consult the Buick Parts Book for the parts or assemblies required. Proceed as follows:

Removal

1. Follow Steps 1 thru 9 on front coil spring removal, Section 7-13, subparagraph b.

2. Remove cotter pin from bolt of lower control arm. Now remove castellated nut and bolt. Remove lower control arm.

3. If lower control arm bushing is to be removed it may be pushed or driven from the frame using a suitable tool.

Installation

1. New lower control arm bushing should be driven into hole in frame until it bottoms against frame.

2. Slip lower control arm over bushing and install bolt and castellated nut. Torque nut to 100 ft. lbs. and install cotter pin. Do not back off nut to align hole in bolt for cotter pin installation. Bend tabs of cotter pin.

3. Follow Steps 1 thru 14 on replacement of front coil springs, Section 7-13, subparagraph b.

7-16 REAR SUSPENSION SERVICE PROCEDURES

a. Removal and Installation of Lower Control Arm

Removal

1. Follow Steps 1 thru 7 for removal of the rear springs, Section 7-13, subparagraph c. Spring need only be disconnected at the lower seat.

2. With the bottom of the spring positioned off of the control arm and towards the differential carrier, raise rear axle assembly to permit reconnecting shock absorber to lower bracket. This is done to help maintain position of

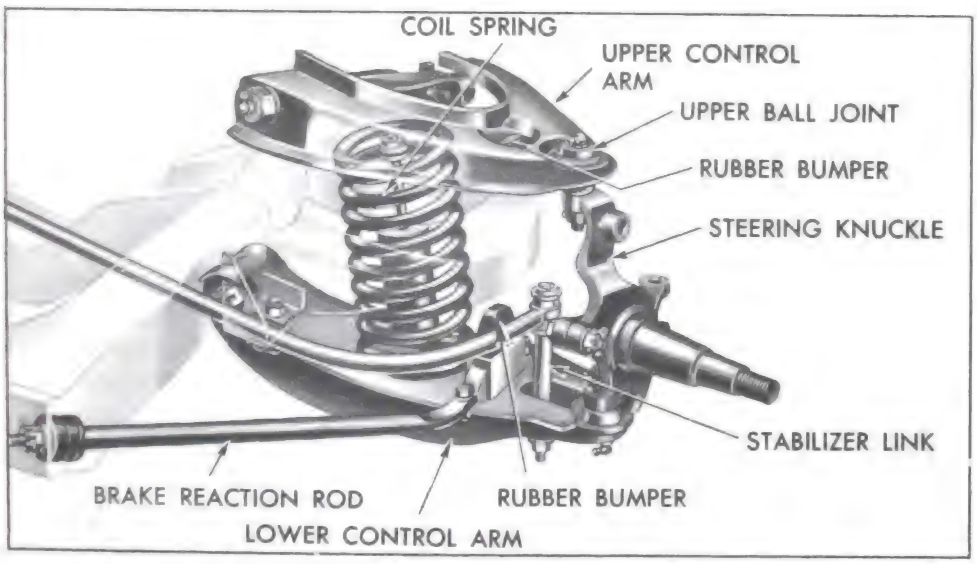


Figure 7-25—Front Suspension

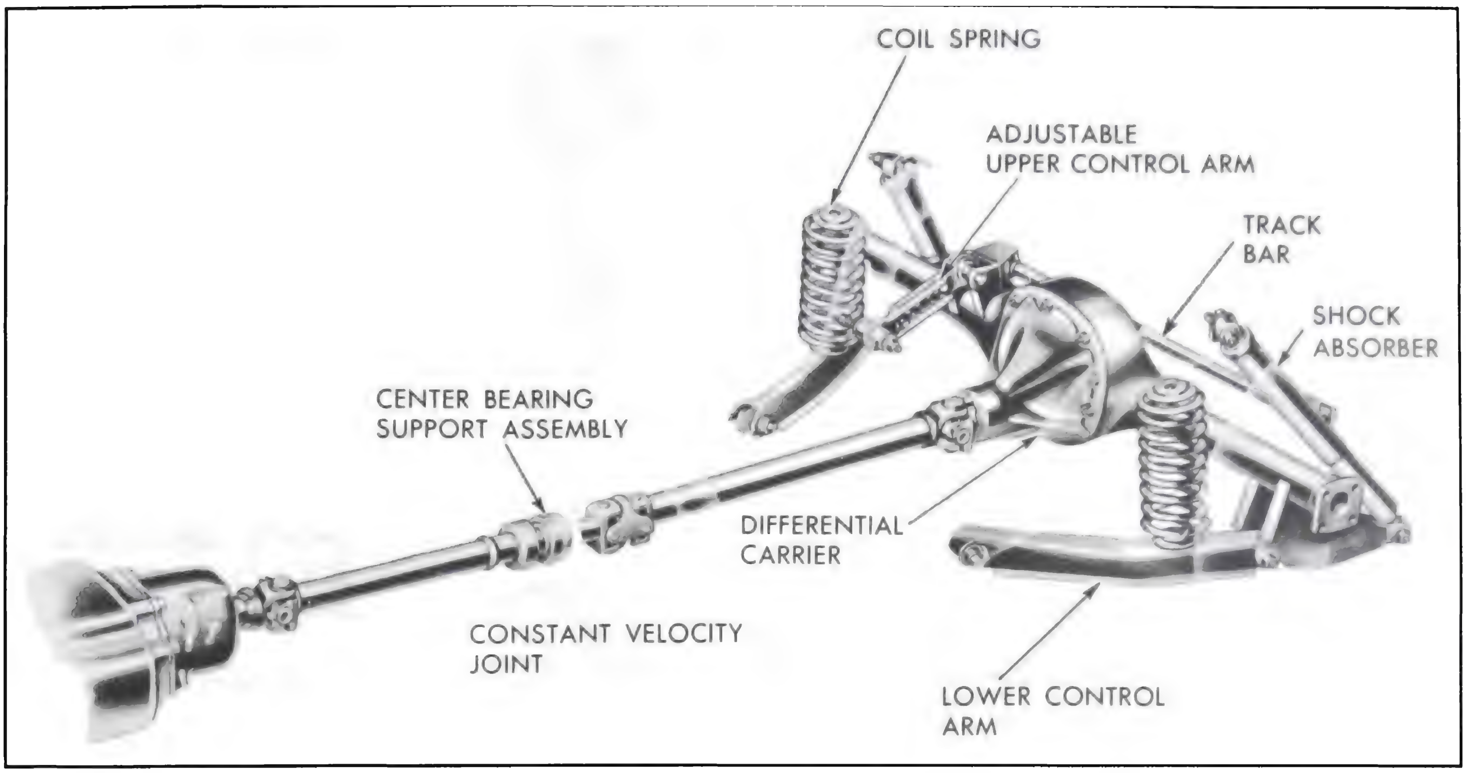


Figure 7-26—Rear Suspension

rear axle assembly so as to reduce binding of lower control arm and thus facilitate removal.

3. With housing still supported, remove lower control arm rear bracket bolt. If some difficulty is encountered in removing bolt, reposition jack farther forward under nose of carrier and slowly raise to relieve pressure and bind at control arm bushing. It may be necessary to use suitable brass drift to tap out bolt.

4. Remove lower control arm front bracket nut and bolt. After nut is removed it may be necessary to tap out bolt with brass drift. Remove lower control arm.

Installation

1. Before installing control arm, check front edges of control arm brackets and remove burrs as necessary. Check all bolts, replace as necessary.

2. Position control arm in front bracket and install bolt, lock washer and nut. Do not tighten.

3. Slowly raise rear axle assembly until control arm rear bushing is aligned with bracket bolt hole. It may be necessary to line up bolt holes with a tapered punch to permit installation of bolt, lock washer and nut. Do not tighten.

4. Disconnect shock absorber at lower end. Lower rear axle assembly to allow positioning of spring in its seat on the lower control arm. Place a short piece of 2 x 4 between the lower end of the spring and axle housing. See Figure 7-24. This assembly aid holds the spring forward on the lower control arm to facilitate attachment of the spring to the lower control arm.

5. Insert spring seat between spring and control arm. Insert a long tapered punch through the control arm bolt hole from the bottom to maintain alignment of the control arm and spring seat hole.

6. Slip spring clamp over punch and position straight side of clamp along straight end of spring.

7. Spring should be at frame top as follows:

Left - top spring end towards rear of car

Right - top spring end towards front of car

If springs are not positioned in this manner loosen top spring clamp bolts, reposition springs, and retorque spring clamp bolts to 17 ft. lbs. Hold spring in position, and with lower spring clamp plate correctly positioned, install bolt with nut on bottom and torque to 25 ft. lbs.

8. Raise rear axle assembly to reconnect shock absorber at lower bracket. Remove short piece of 2 x 4 behind spring.

9. Tighten shock absorber bolt to a minimum of 35 ft. lbs. and tighten control arm bushing bolts to 75 ft. lbs.

NOTE: Car should be in normal load position when tightening shock absorbers and lower control arms. Thus where possible car should be supported by wheel

hoist, by axle contact hoist, or on wheel stands. If this is impossible due to equipment on hand, simulating normal load height with jack under rear axle housing could be done.

10. Carefully attach the propeller shaft to the rear companion flange observing the following precautions:

a. Compress the bearing cups using a 4" C-clamp to assure that the snap rings do not gouge the companion flange when seating. See Figure 6-70.

b. Do not use the U-bolts to draw the bearing cups into place. U-bolts should be seated and the nuts drawn up evenly.

11. Use Torque Wrench Adapter J-9113 to torque U-bolts nuts to 13 ft. lbs.

12. Reinstall brake line bracket to rear suspension cross member.

13. Remove car stands and lower car.

b. Track Bar Service and Replacement

Removal

1. Raise car and support axle housing so weight of car will be on rear springs.

2. Remove pivot bolt and nut attaching track bar to bracket on axle housing.

3. Remove pivot bolt and nut attaching track bar to track bar bracket on left side of car.

4. Track bar can now be removed from brackets.

5. If track bar bracket is to be removed, remove three bolts, washers, and nuts attaching track bar bracket to frame side rails and remove track bar bracket. See Figure 7-28.

Inspection

1. If track bar is bent it should be replaced. No attempt should

Figure 7-27—Track Bar-Axle Attachment

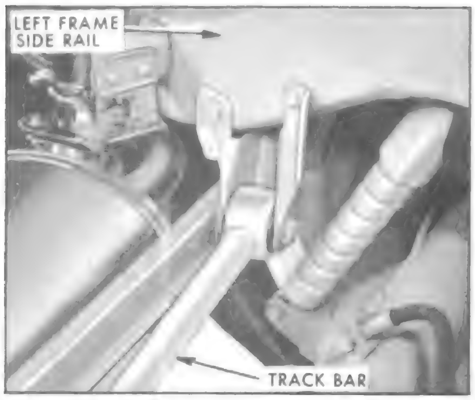


Figure 7-28—Track Bar-Frame Attachment

be made to straighten it.

2. Check rubber bushings for evidence of deterioration, tears, etc. Examine center steel sleeve for excessive wear or separation from rubber.

Removal and Replacement

1. Press out old bushing from side which has no flange using a ram 1 7/8" O.D. Considerable force may be required to remove the bushing.

2. Install new bushing in track bar eye by pressing on flanged side of bushing. Press in bushing until flange is in contact with eye of track bar.

Installation

NOTE: Track bar to bracket bolts must not be tightened unless car is at normal trim height.

1. If track bar bracket was removed install three bolts, washers, and nuts to attach track bar bracket to frame side rails. Torque to 60 ft. lbs.

2. Install pivot bolt and nut attaching track bar to track bar bracket on left side of car. Do not tighten.

3. Install pivot bolt and nut attaching track bar to bracket on axle housing. Torque nut to 120 ft. lbs.

4. Torque track bar nut on left side of car to 120 ft. lbs.

7-17 SHOCK ABSORBER SERVICE AND REPLACEMENT

a. Checking Shock Absorbers

Both front and rear shock absorbers are filled and sealed in production and cannot be refilled in service.

b. Removal and Installation of Front Shock Absorber

1. Remove upper mounting stem nut, grommet retainer and grommet. A 1/4" flat on shock stem may be used to hold stem while removing nut.

2. Remove two lower mounting bracket to lower control arm bolts. Lower shock through lower control arm.

3. Make certain the shock absorber being installed is correct for car model as indicated by part number stamped on outer tube. See Master Parts List, Group 7.345.

4. Assemble lower grommet retainer and grommet on shock stem. Extend shock and install through lower control arm.

5. Install two shock bracket to lower control arm bolts and lock washers. Tighten to 20 ft. lbs.

6. Assemble top grommet, grommet retainer, and nut on stem.

c. Removal and Installation of Rear Shock Absorber

1. Raise rear of car.

2. Remove lower shock absorber mounting eye bolt and nut.

3. Remove upper shock absorber mounting nut, washer and bushing. Remove shock absorber.

4. Inspect all rubber bushings and grommets and replace if not in good condition. If shock absorber operation is faulty, it must be replaced as it cannot be repaired.

5. Make certain the new shock absorber is correct for car model as indicated by part number stamped on the outer tube. See Master Parts List, Group 7.345 for standard and optional parts.

6. Assemble bushing in upper shock eye. Place shock with bushing over stud in frame, install flat washer and nut. Torque nut to 40 ft. lbs.

7. Lower rear end of car. Then tighten pivot bolt to a minimum of 35 ft. lbs.

NOTE: Car weight must be on rear wheels when tightening shock absorber lower ends to clamp rubber bushings in a neutral position.

Shock absorber calibrations as furnished in production have been carefully engineered to provide the best ride control over a wide range of driving conditions. Substitution of other calibrations may adversely affect car performance and is not recommended by Buick Motor Division.

7-18 FRONT WHEEL ALIGNMENT

Wheel alignment is the mechanics of properly adjusting all the factors affecting the position of front wheels so as to cause the car to steer with the least effort and to reduce tire wear to a minimum. Correct alignment of the frame is essential to proper alignment of front and rear wheels. Briefly, the essentials are that the frame must be square in plan view within specified limits, that the top and bottom surfaces of front cross member must be parallel fore and aft, and the bolt holes for support upper arms and lower control arm shafts must be of correct size and location. Checking frame alignment is covered in Group 12.

It should also be understood that wheel and tire balance has an important effect on steering and tire wear. If wheels and tires are out of balance, "shimmy" or "tramp" may develop or tires may wear unevenly, and give the erroneous impression that the wheels are not in proper alignment. For this reason, the wheel and tire assemblies should be known to be in proper balance before assuming that wheels are out of alignment.

Close limits on caster, front wheel camber, and theoretical king pin inclination are beneficial to car handling, but require only reasonable accuracy to provide normal tire life. With the type of front suspension used, the toe-in adjustment is much more important than caster and camber in so far as tire wear is concerned. Caster and camber adjustments need not be considered unless visual inspection shows these settings to be out, or unless the car gives poor handling on the road.

In the majority of cases, services consisting of inflating tires to specified pressure and interchanging tires at recommended intervals (par. 7-8) adjusting steering gear (par. 8-4 manual and par. 8-13 power), and setting toe-in correctly (subpar. e, below) will provide more improvement in car handling and tire wear than will front end alignment adjustments as usually made on front end of alignment equipment.

The use of accurate front end alignment equipment is essential to determine whether front suspension parts have been damaged by shock or accident, and to obtain correct alignment settings after new parts have been installed.

a. Design Considerations Affecting Caster, Camber and Toe Change

The caster angle of an independent front ball-joint suspension is

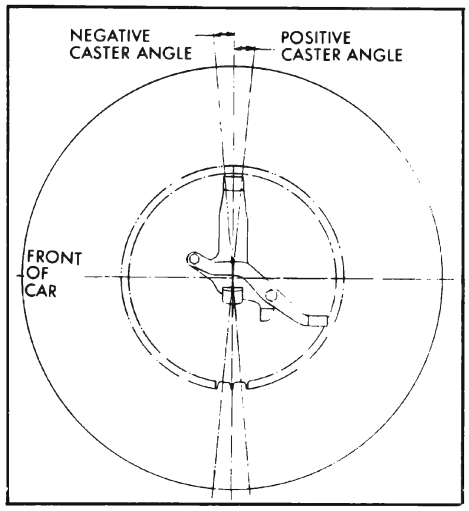


Figure 7-29—Caster Angle

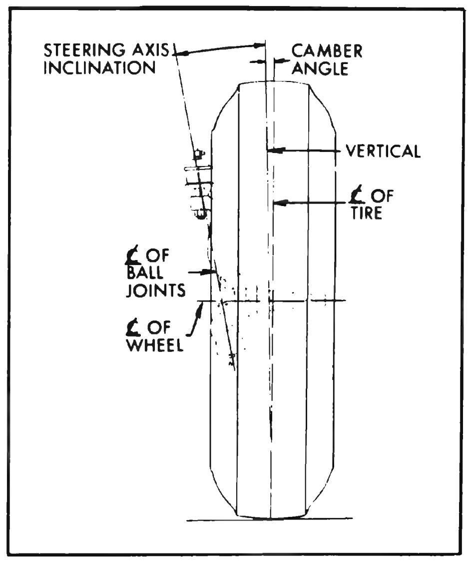


Figure 7-30—Camber Angle and Steering Axis Inclination

the angle made by a line passing through the center of the upper and lower ball joints, and a vertical line through the centerline of the spindle in relation to the ground, when looking at the side of a car. The angle is called "positive" if the upper ball joint is behind the lower, and "negative" if the upper ball is ahead of the lower. See Figure 7-29.

Once the caster has been set, the caster angle will change due to one or both of the following:

1. A change in trim height of the front suspension from the trim at which the caster was set.

2. A change in trim height of the rear suspension from the trim at which the caster was set.

The front suspension is attached to the front spring cross member of the frame. The caster is determined by the angle of the line through the upper and lower front suspension ball joints to the ground. Therefore, the angle of the frame to the ground also controls the caster angle.

Since the caster and camber are in relation to the ground it is necessary to have tires, spindles, wheel bearings, and other related parts correct before setting front-end alignment.

b. Inspection Before Checking Front Wheel Alignment

Before any attempt is made to check or make any adjustment affecting caster, camber, toe-in, theoretical king pin inclination, or steering geometry, the following checks and inspections must be made to insure correctness of alignment equipment readings and alignment adjustments.

1. The front tires should have approximately the same wear and all tires must be inflated to specified pressures (par. 1-2).

2. Check front wheel bearings for looseness and adjust, if necessary (par. 7-10).

3. Check for run-out of wheels and tires and correct to within limit of 1/8" run-out at side of tires, if necessary. (par. 7-7).

4. Check wheels and tires for balance and correct if out of balance (par. 7-8).

5. Check for looseness at ball joints and tie rod ends; if found excessive it must be corrected before alignment readings will have any value (par. 7-5).

6. Check shock absorber action and correct if necessary (par. 7-5).

7. Check trim height, if out of limits, correct with shims or replace spring. CAUTION: Consideration must be given the optional equipment on the car, undercoating, dirt, etc.

Good judgment should be exercised before replacing a spring when car trim height is only slightly out of limits. Spring replacement under conditions of excessive weight as mentioned above will accomplish little and must be accompanied by shimming to obtain saiisfactory results. 1/8" shims are available through Buick Parts warehouses under Group 7.425. Refer to paragraph 7-13.

8. Car must be on level surface. Install alignment height Tool J-8973-23 between frame and lower control arm at each front wheel as shown in Figure 7-31.

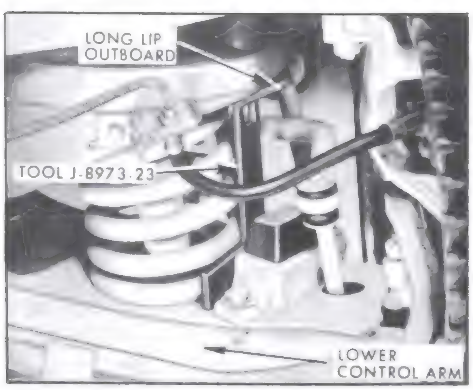


Figure 7-31—Front Alignment Height Tool in Place

Use Tool J-8973-19 in rear between frame and rear axle housing with top of spacer positioned over bolt at rear of bumper. See Figure 7-32. These tools are included in J-8973, Alignment Set.

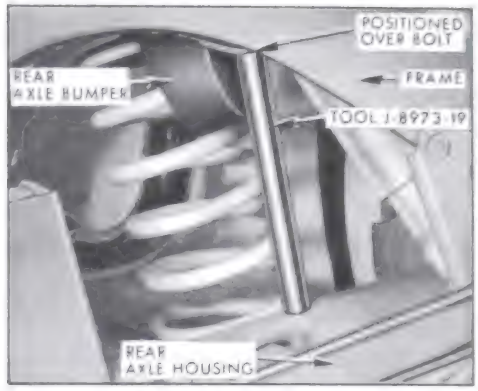


Figure 7-32—Rear Alignment Height Tool in Place

9. It is also advisable to check the condition and accuracy of any equipment being used to check front end alignment, and to make certain that instructions of the manufacturer are thoroughly understood.

c. Checking Caster and Camber Settings

Since caster and camber are both adjusted by shimming in the same locations, both of these settings must be checked before changing either setting.

CAUTION: Regardless of equipment used to check caster and camber, car must be on level surface both transversely and fore and aft. Since camber and caster vary in proportion to the height of the front springs, it is very important that the correct alignment height is maintained while checking (par. 7-18b).

Alignment height is used only when checking and adjusting caster and camber and should not be confused with trim height which is used to establish proper spring dimensions.

THE USE OF HEIGHT TOOLS IS NECESSARY TO MAINTAIN CASTER AND CAMBER AT THE SPECIFIED DESIGN POSITION. IF HEIGHT TOOLS ARE NOT USED, THIS DEFINITE POSITION WILL VARY ACCORDING TO THE CONDITION OF THE CAR. Undercoating, dirt and optional equipment will cause this position to vary. (It is not unusual to find 300 lbs. of dirt on a car).

When equipment is used which bears against the tire or wheel rim to obtain readings, it is very essential that the tires or wheels be checked for run-out. Readings must be taken at points which have no run-out or which lie in the same plane.

Caster and camber should be within the limits shown in Figure 7-34. Note that the caster angles at both front wheels need not be exactly the same but must be within 3/4 degrees of each other. Likewise, the camber angles on both sides must be within 3/4 degrees of each other. If caster and camber are not within the specified limits, adjust as described below.

d. Adjustment of Caster and Camber

Caster and camber may be adjusted by shimming at the upper control arm shaft attaching points. See Figure 7-33.

Production adjustment is done at the upper shaft locations using

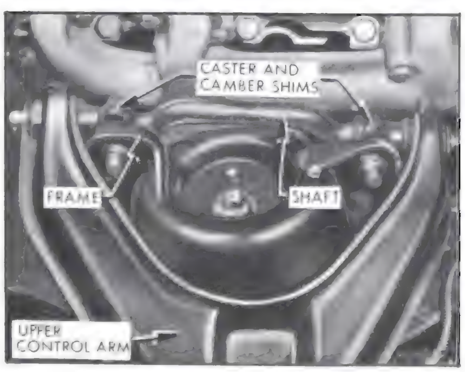


Figure 7-33—Upper Control Arm Shims

shims of .060", .080" and .100". The .080" shims are copper-plated for identification. The shims are horseshoe-shaped and at least one is used in each of the four upper locations. The shims are listed under Group 6.178 of the Master Parts List.

Addition or removal of upper control arm shims will change caster and camber settings. Due to the design of the upper control arm, changing shim patterns will affect both caster and camber at same time. Thus care should be taken to watch both settings when changing one or the other.

To shim at the upper control arm shaft location, it is necessary to wedge the bolt heads to prevent turning, and loosen both front and rear nuts to free the shims for removal or addition. The nuts are accessible from under the car through the use of a standard 7/8" socket, 5" extension. A suitable 13/16" box or open-end wrench may be used to hold the head of the bolt.

To permit maximum accessibility to the nuts, raise the front of the car at the center of the front suspension cross member until both wheels are free. Suitably support the car on car stands. Raising the car in this manner will allow both upper control arms to come to the extreme downward position, exposing nuts.

After installing or removing upper shims (limit .500" in any one stack) tighten and torque upper shaft bolts and recheck alignment. Correct toe-in if necessary. It is imperative to adhere strictly to the torque specifications given in paragraph 7-1.

If customer driving habits require driving on heavily crowded roads and a resultant wandering condition becomes a complaint, camber can be set at the high limit on the left wheel whenever front end alignment is being performed.

A Guide to Caster - Camber Correction 1964 - 4400 - 4600 - 4700 - 4800 Series

1. To Increase Camber Only - (More Positive)

Remove an equal amount of shims at front and rear bolt.

2. To Decrease Camber Only - (Less Positive)

Add an equal amount of shims at front and rear bolt.

3. To Increase Caster Only - (More Negative)

Increase the amount of shims at the front bolt and decrease by an equal amount at the rear bolt.

4. To Decrease Caster Only - (Less Negative)

Decrease the amount of shims at the front bolt and increase by an equal amount at the rear bolt.

5. To Increase Caster and Camber Simultaneously -

Remove shims at rear bolt only.

6. To Decrease Caster and Camber Simultaneously -

Add shims at rear bolt only.

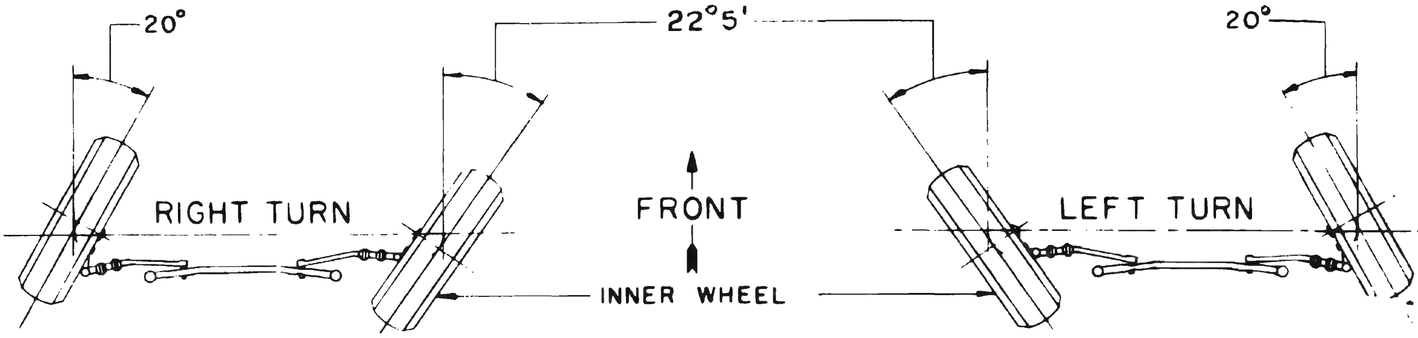
e. Checking and Adjusting Toe-In

CAUTION: Car must be at curb weight and running height, (DO NOT USE ALIGNMENT HEIGHT TOOLS—bounce front end and allow it to settle to running height). Steering gear and front wheel bearings must be properly adjusted with no looseness at tie rod ends. The car should be moved forward one complete revolution of the wheels before the toe-in check and adjustment is started and the car should never be moved backward while making the check and adjustment.

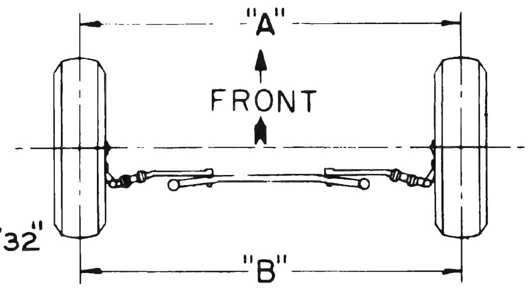
1. Turn steering wheel to straight ahead position, with front wheels in straight ahead position.

2. Measure the horizontal distance from the near edge of front

CHART
FRONT WHEEL ALIGNMENT
4400 - 4600 - 4800 SERIES

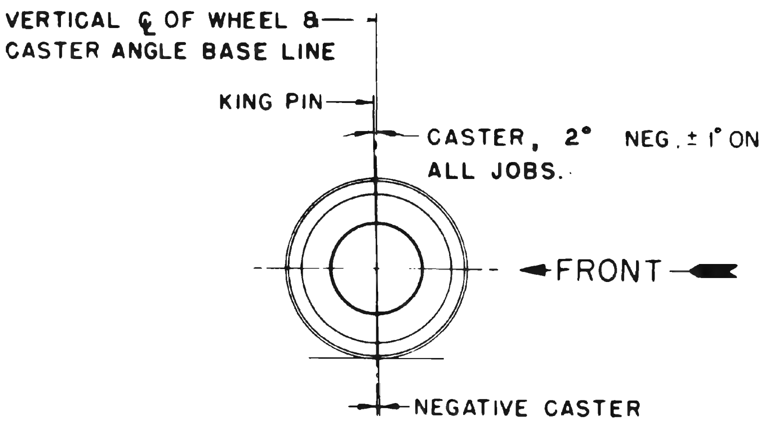


NOTE: WHEN OUTER WHEEL IS TURNED 20° THE INNER WHEEL TURNS— 22°5'

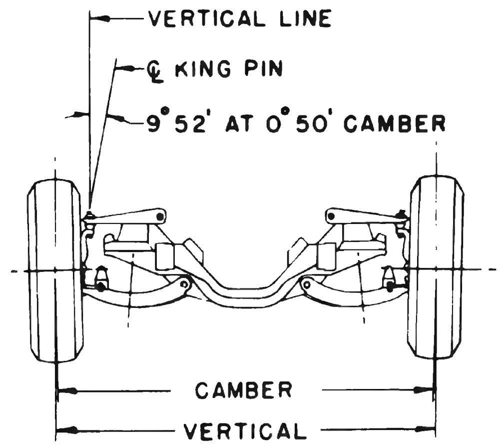


TOE IN 3/16" TO 9/32"

MEASURING FROM A ℄ SCRIBED ON TIRE OR FROM OUTSIDE OF FRONT TIRE, DISTANCE FROM ONE TO THE OTHER "A" SHOULD BE 3/16" TO 9/32" LESS THAN "B"



BOTH SIDES SHOULD BE WITHIN 3/4° OF EACH OTHER



LIMITS OF CAMBER 1° POSITIVE TO 1/2° NEGATIVE
1/3° POSITIVE DESIRED—BOTH WHEELS.
BOTH SIDES SHOULD BE WITHIN 3/4° OF EACH OTHER

NOTE: ALL MEASUREMENTS EXCEPT CASTER AND CAMBER TO BE TAKEN AT CURB WEIGHT WHICH INCLUDES GAS, OIL, WATER, SPARE TIRE & CORRECT TIRE PRESSURE

CASTER & CAMBER SETTINGS MUST BE MADE USING J8973-23 FRONT ALIGNMENT HEIGHT TOOL & J8973-19 REAR ALIGNMENT HEIGHT TOOL FROM J8973 ALIGNMENT SET.

Figure 7-34—Alignment Specifications Chart

boss of lower control arm shaft to the front edge of brake backing plate, on each side. Adjust tie rods, if necessary, to make measurements equal on both sides.

3. Using a suitable toe-in gauge, measure the distance between outside walls of tires at the front at approximately 10" from the floor. See Figure 7-34 dimension "A". Mark points where gauge contacts tires. NOTE: An accurate check also can be made by raising and rotating front wheels to scribe a fine line near the center of each tire, then, with tires on the floor and front end at running height, measure between scribed lines with a suitable trammel.

4. Roll the car forward until measuring points on tires are approximately 10" from the floor at the rear, and measure the distance between points used in Step 3 above. The measurement at the front (dimension "A") should be 7/32" to 5/16" less than the measurement at the rear dimension "B"). See Figure 7-34.

5. If toe-in is not within specified limits, loosen clamp bolts and turn adjusting sleeves at tie rod ends as required. Decrease toe-in by turning left sleeve in same direction as wheel rotates moving forward and turn right sleeve in opposite direction. Increase toe-in by turning both sleeves in opposite direction.

CAUTION: Left and right adjusting sleeves must be turned exactly the same amount but in opposite directions when changing toe-in, in order to maintain front wheels in straight ahead position when steering wheel is in straight ahead position. The rod sleeve clamps must be positioned straight down to 45° to provide frame clearance.

6. After correct toe-in is secured tighten clamp bolts securely.

CAUTION: The steering knuckle and steering arm "rock" or tilt as front wheel rises and falls. Therefore, it is of vital importance to position the bottom face of tie rod end parallel with machined surface at outer end of steering arm. when tie rod length is adjusted. Severe damage and possible failure can result unless this precaution is observed.

f. Checking Steering Geometry (Turning Angles)

CAUTION: Be sure that caster, camber, and toe-in have all been properly corrected before checking steering geometry. Steering geometry must be checked with the weight of the car on the wheels.

1. With the front wheels resting on full floating turntables, turn wheels to the right until the outside (left) wheel is set at 20 degrees. The inside (right) wheel should then set at angle specified in Figure 7-34.

2. Repeat this test by turning front wheels to the left until the outside (right) wheel sets at 20 degrees; the inside (left) wheel should then set at angle specified in Figure 7-34.

3. Errors in steering geometry generally indicate bent steering arms, but may also be caused by other incorrect front end factors. If the error is caused by a bent steering arm it must be replaced. Replacement of such parts must be followed by a complete front end check as described above.

g. Checking Theoretical King Pin Inclination

CAUTION: When checking theoretical king pin inclination, car must be on a level surface, both transversely and fore and aft. It must be maintained at specified alignment height while checking (par. 7-18b).

With camber known to be within specified limits, theoretical king pin inclination should check within specified limits given in Figure 7-34.

If camber is incorrect beyond limits of adjustment and theoretical king pin inclination is correct, or nearly so, a bent steering knuckle is indicated.

If camber and theoretical king pin inclination are both incorrect by approximately the same amounts, a bent upper or lower control arm is indicated.

There is no adjustment for theoretical king pin inclination as this factor depends upon the accuracy of the front suspension parts. Distorted parts should be replaced with new parts. The practice of heating and bending front suspension parts to correct errors is not recommended as this may produce soft spots in the metal in which fatigue and breakage may develop in service.

Figure 7-35—Lower Ball Joint Tools

GROUP 8

STEERING GEAR AND LINKAGE

SECTIONS IN GROUP 8

SECTION 8-A

MANUAL STEERING GEAR

CONTENTS OF SECTION 8-A

8-1 MANUAL STEERING GEAR SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque Ft. Lbs.
Bolt & Nut	Lower Coupling Clamp	5/16-18	20-35
Bolt	Gear Side Cover to Housing	3/8-16	25-40
Bolt	Gear Housing to Frame	7/16-14	60-75
Nut	Lash Adjuster Lock	7/16-20	18-27
Nut	Steering Wheel to Steering Shaft	1/2-20	20-35
Nut	Pitman Arm to Pitman Shaft	7/8-14	90-110

b. Steering Gear Specifications

Items	Specifications
Gear Type	Recirculating Ball Worm and Nut
Make	Saginaw
Ratio, Gear Only	28.0 to 1
Ratio, Overall (Including Linkage)	33 to 1
Turns of Wheel, Lt. to Rt. (Gear connected)	5
Lubrication	Plug in Housing
Oil Capacity	11 oz.
Steering Wheel Diameter	16"
Number and Type of Pitman Shaft Bearings	2 Bushings

b. Steering Gear Specifications (Cont'd)

Items	Specifications
Number and Type of Worm Shaft Bearings	2 Ball Bearings
Worm and Nut Balls - No. and Diameter	50, 9/32"
Lash Adjusting Screw and Shim Clearance in Pitman Shaft	0 to .002"
Adjustments	
Worm Bearing Preload	
Torque at Worm or Steering Shaft	2 to 7 in. lbs.
Lbs. Pull at Steering Wheel Rim	1/4 to 3/4 lb.
Pitman Shaft "Overcenter"	
Torque at Worm or Steering Shaft	4 to 8 in. lbs. Higher than Worm Bearing Preload
Lbs. Pull at Steering Wheel Rim	1/2 to 1 lb. Higher than Worm Bearing Preload
Total "Overcenter" Pull Should Not Exceed	13 in. lbs. or 1 5/8 lbs.

8-2 DESCRIPTION OF MANUAL STEERING GEAR

The steering gear is the recirculating ball worm and nut type. The worm on lower end of the steering shaft and the ball nut which is mounted on the worm have mating spiral grooves in which steel balls circulate to provide a low-friction drive between worm and nut. See Figure 8-1.

Two sets of 25 balls are used, with each set operating independently of the other. The circuit through which each set of balls circulates includes the grooves in worm and ball nut and a ball return guide attached to outer surface of nut.

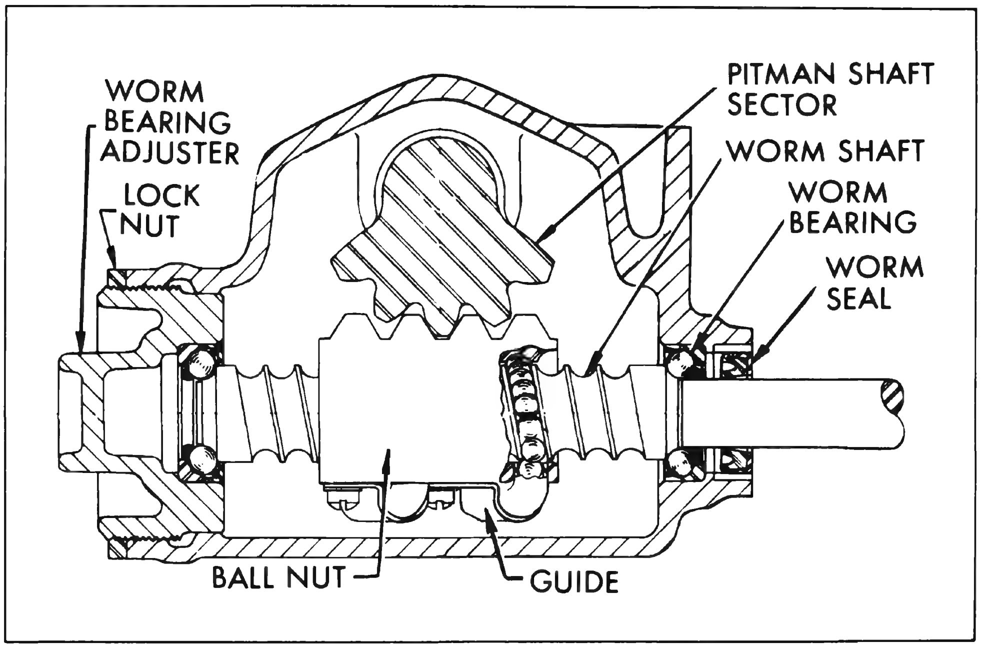


Figure 8-1—Steering Gear Worm and Ball Nut

When the wheel and steering shaft turn to the left the ball nut is moved downward by the balls which roll between the worm and nut. As the balls reach the outer surface of nut they enter the return guides which direct them across and down into the ball nut, where they enter the circuit again. When a right turn is made, the ball nut moves upward and the balls circulate in the reverse direction. See Figure 8-1.

Teeth on the ball nut engage teeth on a sector forged integral with the pitman shaft. The teeth on the ball nut are made so that a "high point" or tighter fit exists between the ball nut and pitman shaft sector teeth when front wheels are in the straight-ahead position. The teeth of sector are slightly tapered so that a proper lash may be obtained by moving the pitman shaft endways by means of a lash adjuster screw which extends through the gear housing side cover. The head of adjuster screw and a selectively fitted shim fit snugly into a T-slot in the end of the pitman shaft, so that the screw also controls end play of shaft. The screw is locked by an external lock nut. See Figure 8-2.

The pitman shaft is carried by a bushing in the steering gear housing and a bushing in the housing

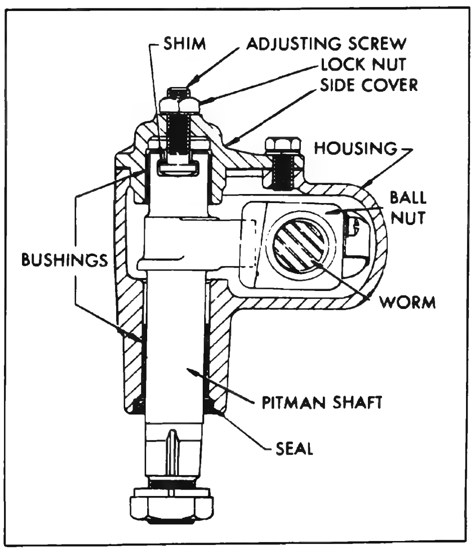


Figure 8-2—Steering Gear Pitman Shaft and Ball Nut

side cover. A seal in the housing prevents leakage of lubricant at the lower end of the shaft. See Figure 8-2.

The steering worm shaft is carried by two ball thrust bearings which bear against seats on the ends of the worm. The outer race of the upper worm bearing is pressed into the gear housing.

The outer race of the lower worm bearing is pressed into the worm bearing adjuster which screws into the housing and is locked by a nut.

This adjuster is turned to provide proper preloading of the upper and lower worm bearings. The steering gear housing is attached to the frame by three bolts.

The upper steering shaft is a separate shaft supported in the steering column jacket. Its upper end is supported by a bearing; its lower end by an adapter and ball bearing assembly.

The upper steering shaft is connected to the steering worm shaft through a universal joint type coupling. This coupling allows slight variations in alignment between the steering gear assembly and the steering column jacket assembly.

8-3 TROUBLE DIAGNOSIS—MANUAL STEERING GEAR

This paragraph covers improper steering actions which are most likely to be caused by the steering gear assembly. Improper steering actions which are most likely to be caused by chassis suspension members are covered in Group 7.

a. Excessive Play or Looseness in Steering System

1. Front wheel bearings loosely adjusted (Group 7).

2. Worn upper ball joints (Group 7).

3. Steering wheel loose on shaft, loose pitman arm, tie rods, steering linkage ball studs or steering arms.

4. Excessive pitman shaft sector to ball nut lash (par. 8-4).

5. Worm bearings loosely adjusted (par. 8-4).

b. Hard Steering—Excessive Effort Required at Steering Wheel

1. Low or uneven tire pressure (par. 1-2)

2. Insufficient or improper lubricant in steering gear or loss of lubricant in front suspension (par. 1-3)

3. Excessive steering shaft coupling misalignment.

4. Steering gear adjusted too tight, or idler arm binding on support (par. 8-21).

5. Front wheel alignment incorrect Group 7.

6. Improper position of mast jacket to lower coupling (See Figure 8-71).

c. Rattle or Chuckle in Steering Gear

1. Insufficient or improper lubricant in steering gear (par. 1-3)

2. Excessive back lash between ball nut and pitman shaft sector in straight ahead position or worm thrust bearings adjusted too loose (par. 8-4). NOTE: On turns a slight rattle may occur, due to the increased lash between ball nut and sector as gear moves off the center or "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.

3. Pitman arm loose on shaft, or steering gear loose at frame.

4. Loose steering shaft bearings.

8-4 ADJUSTMENT OF MANUAL STEERING GEAR

IMPORTANT: Never attempt to adjust the steering gear while it is connected to the intermediate rod. The steering gear must be free of all outside load in order to properly make any steering gear adjustment.

NOTE: If an inch pound torque wrench is not available, a spring scale may be used to check adjustment following specifications in paragraph 8-1, b.

a. Adjustment of Steering Gear in Car

There are two adjustments on the steering gear: worm bearing preload, and pitman shaft overcenter preload.

1. Torque steering gear to frame bolts to 70 ft. lbs. Torque pitman arm nut to 100 ft. lbs.

2. Remove pitman nut. Disconnect pitman arm from pitman shaft using Puller J-5504. See Figure 8-28.

3. Turn steering wheel slowly from one extreme to the other. CAUTION: Never turn the wheel hard against the stopping point in the gear, as damage to the ball nut assembly may result.

Steering wheel should turn freely and smoothly through entire range. Roughness indicates faulty internal parts, requiring disassembly of the steering gear. Hard pull or binding indicates an excessively tight adjustment of worn bearings, or excessive misalignment of steering shaft coupling. Any excessive misalignment must be corrected before steering gear can be properly adjusted.

4. Remove cap from steering wheel. See Figure 8-6.

5. Check Worm Bearing Preload. Turn steering wheel gently in one direction until it stops. This positions gear away from "high point" load.

6. Attach Torque Wrench J-5853 to steering wheel retaining nut and check the torque required to turn the wheel steadily in the range where lash exists between ball nut and pitman shaft sector. See Figure 8-4. The torque required to keep wheel turning should be between 2 and 7 inch pounds. Adjust worm bearing preload if necessary.

7. Adjust Worm Bearing Preload. Loosen worm bearing adjuster lock nut using a drift. See Figure 8-3. Turn bearing adjuster as required to bring pull between 2 and 7 inch pounds. Tighten lock nut, then recheck preload.

8. Torque side cover bolts to 30 ft. lbs.

9. Check Pitman Shaft Overcenter Preload. Turn steering wheel from one extreme to the other while counting the total turns, then turn wheel back 1/2 the number of turns. This positions steering gear on "high

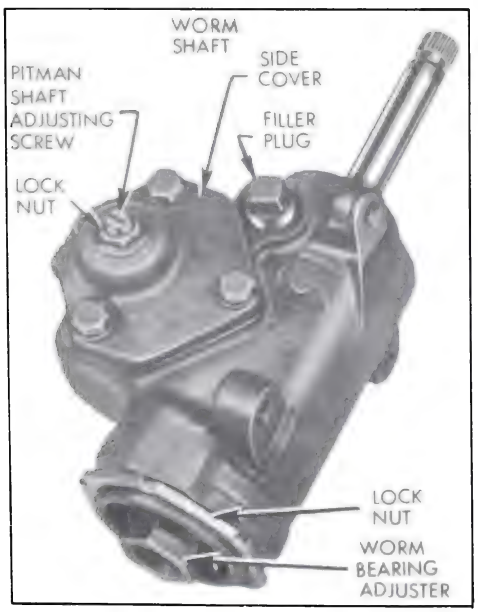


Figure 8-3—Manual Steering Gear Adjusters

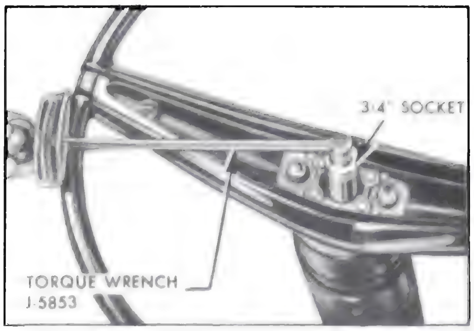


Figure 8-4—Checking Adjustments in Car

point" where a preload should exist between ball nut and pitman shaft teeth.

10. Check the torque required to turn wheel through the "high point" range. Torque should be between 4 and 8 inch pounds higher than worm bearing preload. Total "overcenter" pull should not exceed 13 inch pounds.

11. Adjust Pitman Shaft Overcenter Preload. Loosen locknut and turn pitman shaft lash adjuster screw as required to bring torque between 4 and 8 inch pounds higher than worm bearing preload. After tightening locknut, rotate steering wheel back and forth through the "high point" and through the entire range to check for tight spots.

NOTE: If lash cannot be removed at "high point", or if gear load varies greatly and feels rough, gear assembly should be removed for inspection of internal parts.

12. When installing pitman arm on pitman shaft, torque nut to 100 ft. lbs.

b. Adjustment of Steering Gear on Bench

1. Attach Torque Wrench J-5853 to worm shaft and turn shaft to extreme right or left position. See Figure 8-5.

2. Turn worm bearing adjuster to obtain a reading of 2 to 7 inch pounds with worm shaft turning slowly. Worm bearing preload

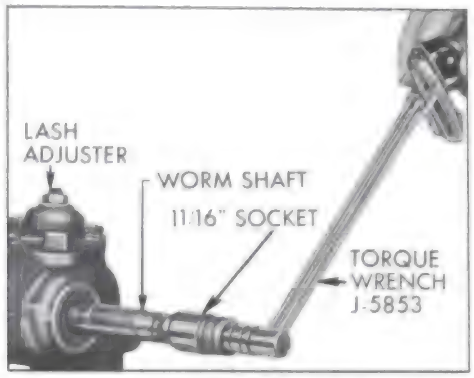


Figure 8-5—Checking Adjustments on Bench

adjustment must be made within 1/2 turn of worm shaft from extreme position.

3. Tighten worm bearing adjuster locknut and recheck reading.

4. Turn worm shaft from one extreme to the other while counting turns, then turn back 1/2 the total number of turns. This places the steering gear on the "overcenter" or "high point" position.

5. Loosen pitman shaft lash adjuster locknut and turn lash adjuster until a reading of 4 to 8 inch pounds higher than worm bearing preload is obtained while rotating worm shaft through the "overcenter" range. Tighten lock nut and recheck reading. Total "overcenter" pull should not exceed 13 inch pounds.

c. Road Test after Adjustment

Road test car for ease of steering. If steering gear was adjusted to specified load limits and hard steering exists, the front suspension members should be checked for lubrication and alignment and tire inflation pressures should be checked. When car is moving straight ahead, the steering wheel should be in the straight-ahead position, or not over 5/8" to either side of the straight-ahead position. If steering wheel is too far to either side, check wheel for proper position on steering

shaft (par. 8-5) and check tie rods for equal adjustment and toe-in (Group 7). It is important to have the steering gear in the no-lash "overcenter" range when car is moing straight forward.

8-5 STEERING WHEEL REMOVAL AND INSTALLATION

a. Removal of Steering Wheel

1. Unplug horn ground wire connector at mast jacket to prevent horn from blowing.

2. Remove actuator cap, actuator bar, springs and ground plate from steering wheel. See Figure 8-6.

3. Loosen steering wheel retaining nut several turns. Do not remove nut.

4. Attach Puller J-3274 to wheel hub and pull wheel up to nut. See Figure 8-7. If wheel hub is very tight on shaft, apply a moderate strain with puller then tap end of puller screw to break hub loose from shaft without distorting wheel hub. Remove puller, nut, and steering wheel.

b. Installation of Steering Wheel

1. Apply lubriplate to horn contact brush and ring.

2. Install steering wheel with location marks on shaft and hub of wheel in line. See Figure 11-92.

NOTE: Location marks for proper installation of steering wheel on steering shaft are provided to insure a straight-ahead position of the steering wheel when front wheels are in straight-ahead position. See Figure 8-8.

3. With wheel properly located on shaft, install Stake nut and tighten to 30 ft. lbs. in place.

4. Install horn parts on steering wheel.

5. Plug horn wires together at mast jacket.

8-6 REMOVAL AND INSTALLATION OF MANUAL STEERING GEAR

a. Removal of Steering Gear Assembly

1. Remove steering shaft to gear coupling clamp bolt and nut. Slide clamp off coupling.

2. Jack up car and remove the pitman shaft nut and lock washer, then remove the pitman arm, using Puller J-5504. See Figure 8-28.

3. Loosen the three steering gear to frame bolts to complete removal of gear.

b. Installation of Steering Gear Assembly

1. Install the gear assembly by reversing the procedure for removal. Make sure that slot in coupling lines up with mark on worm shaft. See Figure 8-9.

2. Torque the pitman arm nut to 100 ft. lbs. and frame to gear bolts to 70 ft. lbs.

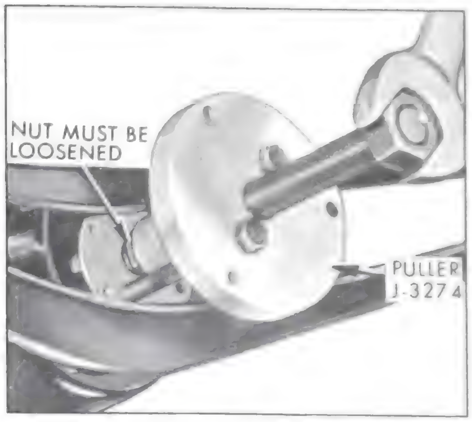


Figure 8-7—Removing Steering Wheel

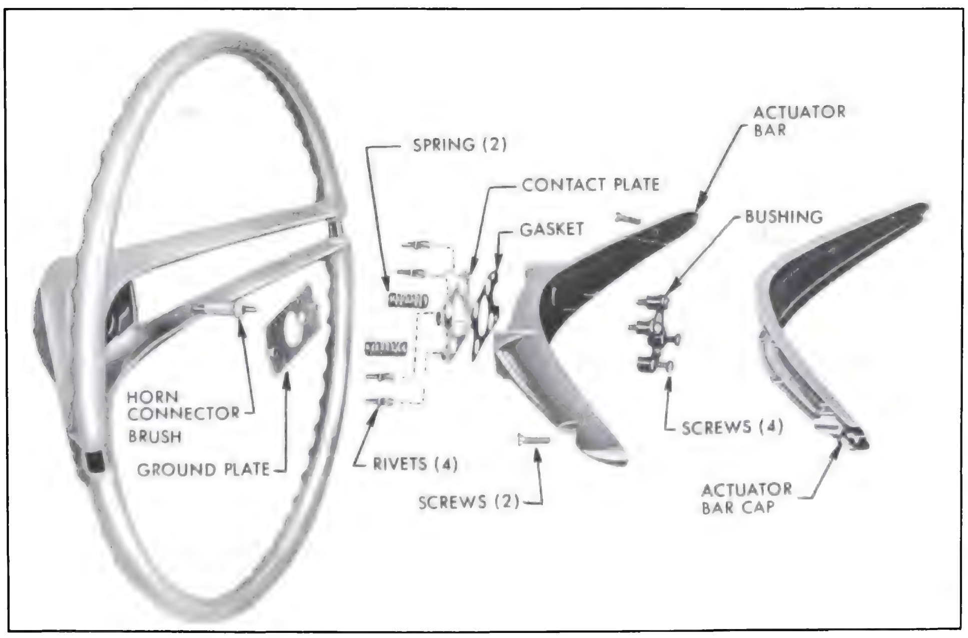


Figure 8-6—Steering Wheel Assembly

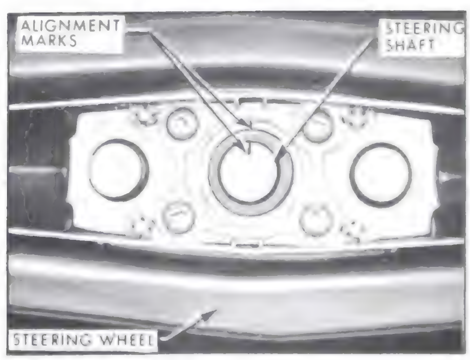


Figure 8-8—Steering Wheel and Shaft Alignment Marks

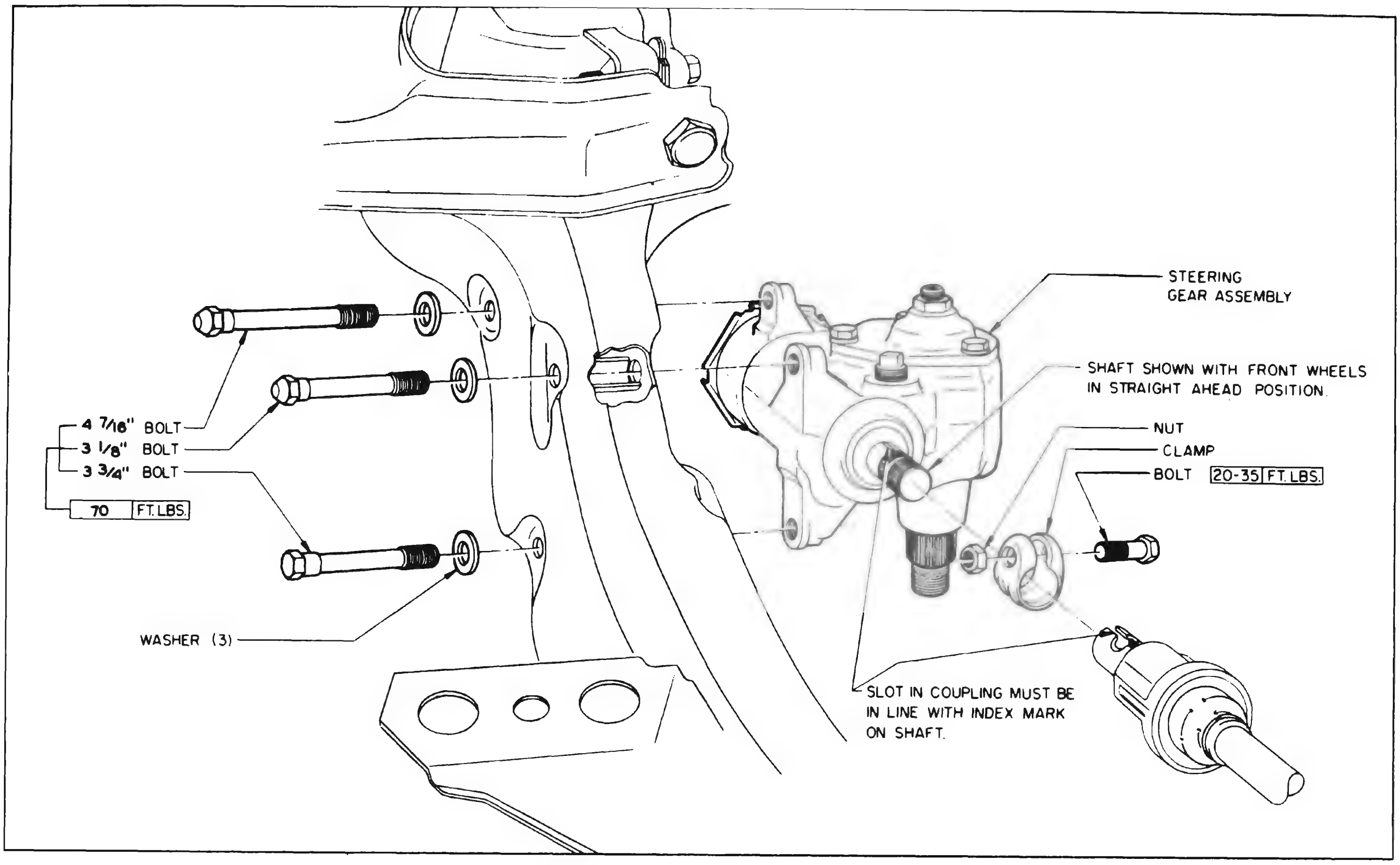


Figure 8-9—Manual Steering Gear Installation

3. Position clamp on coupling and install bolt and nut. Torque to 35 ft. lbs.

8-7 DISASSEMBLY, INSPECTION, ASSEMBLY OF MANUAL STEERING GEAR AND STEERING SHAFT COUPLING

a. Disassembly of Steering Gear

It is not necessary to disassemble gear to replace worm shaft seal. Remove worm seal with awl being careful not to damage housing or shaft and install a new seal with Installer J-8564. See Figure 8-12.

1. Mount steering gear assembly in a vise.

If only pitman shaft seal is going to be replaced do not disassemble pitman shaft and side cover, but remove and install as an assembly.

2. Rotate worm shaft to center of travel.

3. Remove pitman shaft adjusting screw locknut. Remove three side cover bolts.

4. Remove side cover by turning lash adjuster clockwise through cover. Slip lash adjuster with shim from slot end of pitman shaft. Remove and discard side cover gasket.

5. Remove pitman shaft from housing by lightly tapping on spline end with a soft mallet. Pry pitman shaft seal out of housing with a screwdriver. Discard seal.

6. Loosen worm bearing adjuster locknut with a punch and remove worm bearing adjuster and locknut.

7. Remove worm shaft and ball nut assembly and upper worm bearing from housing.

8. Remove lower worm bearing from adjuster by prying retainer out with a screwdriver.

9. Remove ball return guide clamp and guides from ball nut. Turn ball nut over and rotate worm shaft back and forth until all balls (50) drop out into a clean cloth. Remove ball nut from worm shaft.

10. Pry worm shaft seal from housing with screwdriver. Discard seal.

b. Inspection of Steering Gear

1. Wash all parts in clean solvent and wipe dry with a clean lint free cloth.

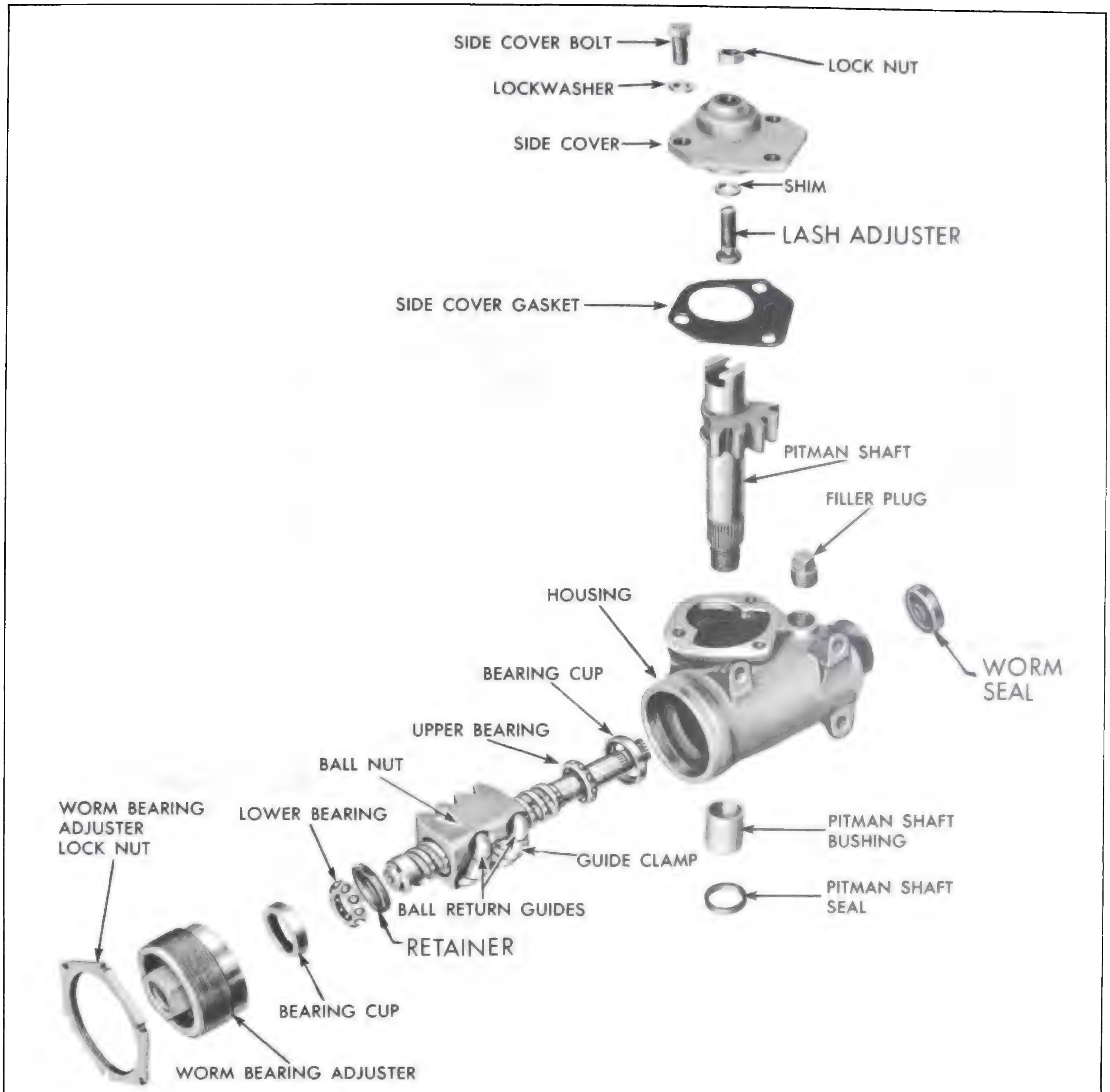


Figure 8-10—Manual Steering Gear - Exploded View

2. Inspect worm bearings and cups for damage or excessive wear. Replace bearings if necessary. The lower worm bearing cup is not replaced separately, but is serviced with the worm bearing adjuster. If upper worm bearing cup is defective, drive cup out of housing with a punch and install new cup using Installer J-8811 with Driver Handle J-8092.

3. Check fit of the pitman shaft in the bushing in side cover. If bushing is worn, side cover must be replaced as bushing is not serviced separately.

4. Inspect the worm and nut balls and the grooves of worm and nut for damage or excessive wear. Replace parts as necessary.

5. Inspect teeth of ball nut and pitman shaft for pitting or scoring which would require replacement of nut or pitman shaft.

Inspect pitman shaft bushing for excessive wear or scoring. If necessary, remove pitman shaft bushing and install a new bushing with Remover and Replacer J-8810 and Driver Handle J-8092.

6. Check pitman shaft surface for wear or scoring, then check fit of pitman shaft lash adjuster and shim in the slot in end of pitman shaft by inserting feeler gauge between the head of screw and bottom of slot. Adjuster must be free to turn and end play should not exceed .002". If end play exceeds .002" install proper shim. The shims are available in four different thicknesses .063", .065", .067" and .069".

7. Check ball guides for damage and replace if necessay.

c. Assembly of Steering Gear

NOTE: Lubricate all seals, bushings, bearings and gears with multi-purpose gear lubricant just before assembling.

1. Position ball nut over worm shaft so that deep side of teeth will be toward side cover when installed in gear housing. Install 19 balls in each circuit (rock worm shaft slightly to aid in installing balls). Place 6 balls in each return guide, using grease to hold balls in place. Install return guides, clamp and screws. Rotate worm through its complete travel several times to insure balls are installed correctly and rotate freely.

2. Place upper bearing on worm shaft and slide worm shaft assembly into housing.

3. Place lower bearing in worm bearing adjuster and install bearing retainer with Installer J-8564. Install adjuster assembly with locknut in housing. Tighten adjuster only enough to hold worm bearings in place. Final adjustment will be made later.

4. Turn worm shaft until center groove in ball nut lines up with center of pitman shaft bushing. Install pitman shaft and lash adjuster with shim so that center tooth meshes with center groove in ball nut.

5. Place new gasket on side cover. Install side cover with gasket on lash adjuster by turning adjuster counterclockwise.

6. Install three side cover bolts and lock washers. Torque to 30 foot pounds.

7. Turn lash adjuster so that teeth on shaft and ball nut engage but do not bind. Install lash adjuster lock nut loosely. Final adjustment will be made later.

8. To protect pitman shaft seal from damage, cover shaft splines with masking tape. Slide new seal into place and seat against shoulder in housing using Installer J-8569. See Figure 8-11.

9. Install new worm shaft seal using Installer J-8564. See Figure 8-12. Drive seal flush with surface of housing.

10. Fill steering gear with multi-purpose gear lubricant. Gear is now ready for final adjustment on bench is described in paragraph 8-4.

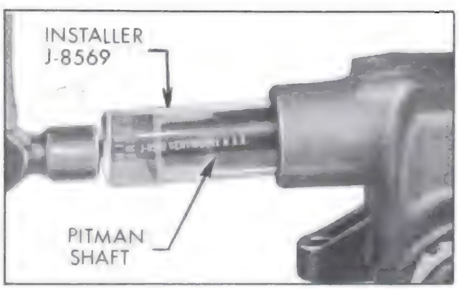


Figure 8-11—Installing Pitman Shaft Seal

d. Disassembly of Steering Shaft Coupling

1. Remove steering gear (par. 8-6).

2. Remove coupling seal retainer. See Figure 8-13.

3. Mark steering shaft in line with slot in coupling clamp area and slide coupling housing off shaft, being careful not to allow parts to fall out on floor.

4. Remove the anti-click spring and the two pivot bearings.

5. Remove washer from shaft.

6. Remove seal if it is going to be replaced.

e. Assembly of Steering Shaft Coupling

1. Lubricate the coupling parts and pack the coupling housing with aluminum soap type chassis lubricant.

2. Install seal and washer on shaft.

3. Install the pivot bearings and the anti-click spring on shaft pin

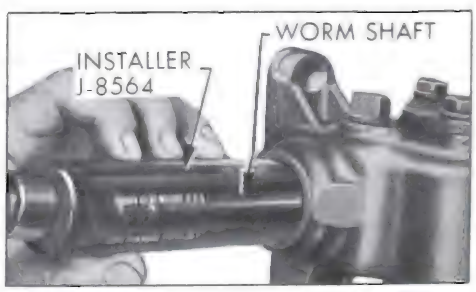


Figure 8-12—Installing Worm Shaft Seal

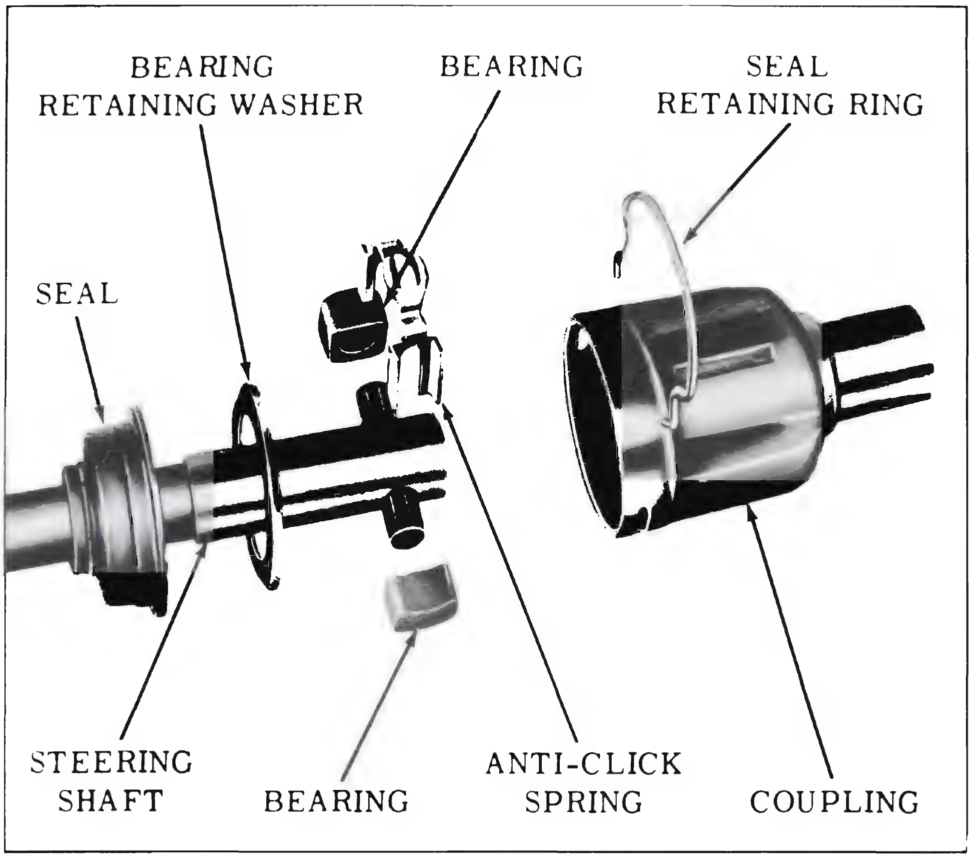


Figure 8-13—Manual Steering Shaft Coupling Assembly

so that the two machined surfaces of the bearings will be against side of coupling housing.

4. Install coupling housing on the steering shaft with the slot of coupling clamp surface aligned with mark on shaft.

5. Insert the seal into coupling housing and install retainer ring.

6. Install steering gear (par. 8-6).

SECTION 8-B

POWER STEERING GEAR AND PUMP

CONTENTS OF SECTION 8-B

8-8 POWER STEERING GEAR AND PUMP SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

NOTE: See Figures 8-29 and 8-30 for pump mounting bolts and nuts.

Part	Location	Thread Size	Torque Ft. Lbs.
Bolt	Lower Coupling Flange Pinch	3/8-24	20-35
Bolt	Gear Side Cover to Housing	3/8-16	25-35
Stud	Pump Reservoir to Housing	3/8-16	25-35
Bolt	Gear Housing to Frame	7/16-14	60-75
Union	Pump Pressure Outlet	5/8-18	25-35
Nut	Steering Wheel to Steering Shaft	1/2-20	20-35
Nut	Pitman Arm to Pitman Shaft	7/8-14	90-110
Nut	Pulley to Pump Shaft	1/2-20	40-45
Nut	Rear Mounting Bracket to Pump	3/8-16	25-35
Nut	Lash Adjuster Lock	7/16-20	20-30
Plug	Rack Piston Nut End	1 5/16-16	35-65

b. Steering Gear Specifications

Items	Specifications
Gear Type	Recirculating Ball Nut and Worm
Make	Saginaw
Ratio, Gear Only	17.5 to 1
Ratio, Overall (Including Linkage)	20.5 to 1
Steering Wheel Diameter	16"
Effort Necessary at Wheel Rim for Initial Hydraulic Assist	Approx. 1 lb.
Effort Necessary at Wheel Rim for Full Hydraulic Assist	Approx. 3 1/4 lbs.
Turns of Steering Wheel, Left to Right (Gear Connected)	3 1/2
Steering System Oil	Hydraulic Steering Oil or Automatic Transmission Oil
Steering System Oil Capacity (Dry)	1 1/4 qts.

b. Steering Gear Specifications (Cont'd.)

Items	Specifications
Worm and Rack—Piston Nut Balls—No. and Diameter	11 Black, 11 Plain, 6 Sizes Plain From .28117 (Code 6) to .28157 (Code 11) by .00008th
Adjustments	
Thrust Bearing Preload (Including Valve Assembly Drag)	
Torque at Stub or Steering Shaft	1 to 11 in. lbs.
Lbs. Pull at Steering Wheel Rim	1/4 to 1 1/2 lb.
Worm and Rack Ball Preload	
Torque at Stub or Steering Shaft	1 to 5 in. lbs. Higher than Thrust Bearing Preload
Lbs. Pull at Steering Wheel Rim	1/8 to 5/8 lb. Higher than Thrust Bearing Preload
Pitman Shaft "Over Center"	
Torque at stub or Steering Shaft	4 to 8 in. lbs. Higher than Worm and Rack Ball Preload
Lbs. Pull at Steering Wheel Rim	1/2 to 1 lb. Higher than Worm and Rack Ball Preload

c. Pump Specifications

Pump Capacity. Gal./Min. @ 485 RPM (Engine) x 700 psi	1.75 Minimum
Relief Valve Opening Pressure, psi	1100 to 1200
Pump Test Pressure, Min. psi. @ 485 RPM (Engine) and 170^{o} F. Oil Temperature	1000 Minimum
Drive Belt Adjustment	See Fig. 2-39

8-9 DESCRIPTION OF POWER STEERING GEAR AND PUMP

The rotary valve power steering system is standard equipment on the 4700 and 4800 Series and is offered as optional equipment on the 4400 and 4600 Series.

The rotary valve power steering gear gives precise, positive steering with very little driver effort. Initial hydraulic assist is obtained with approximately .3 degrees of steering wheel rotation and one pound of effort at the steering wheel rim. Full hydraulic assist is obtained with approximately 4 degrees of wheel rotation and 3-1/4 pounds of effort at the wheel rim.

The hydraulic pump is used to supply oil under pressure to operate the steering gear. The housing of the pump is enclosed in a reservoir which minimizes the possibilities of external leakage. A twist-off cap is used on the reservoir to simplify checking the oil level.

With the engine running, steering is manual under conditions which require an effort of less than one pound at the steering wheel rim. When a greater effort is required, the power mechanism operates to assist in turning the front wheels. The effort then required of the steering wheel rim is limited to a maximum of approximately 3-1/4 pounds for normal steering and parking conditions.

When the engine is not running or if any part of the power mechanism is inoperative the steering gear will operate manually giving the driver full control of the car.

The driver's effort on the steering wheel is always proportioned to the force necessary to turn the front wheels. When the effort on the wheel drops to less than one pound, power assistance ceases. When the steering wheel is released to recover from a turn, the front wheels return to the straight-ahead position in the normal manner without assistance or interference from the power mechanism. Through this conventional steering action the driver always has the "feel" of steering.

a. Power Steering Gear Assembly

The power steering gear assembly is the recirculating ball type, having a ratio of 17.5 to 1.

The upper end of the pitman shaft has a gear sector meshing with a rack-piston nut. The one-piece rack-piston nut serves as a nut for the recirculating balls and as a power piston to which the oil under pressure is applied. The rack-piston nut has a Teflon piston ring with a back-up "O" ring under it located on its lower outside diameter which serves as a seal between the rack-piston nut and its cylinder gear housing. A snap ring serves as a stop for the piston at the upper end and the housing end plug serves as a stop at the lower end. See Figure 8-14.

A worm shaft turns in the rack-piston nut using the selectively fitted steel balls as a rolling thread. The ball groove is shallower in the center of the worm so that when the proper size balls are used, there is a slight worm to rack-piston nut preload in the straight-ahead position.

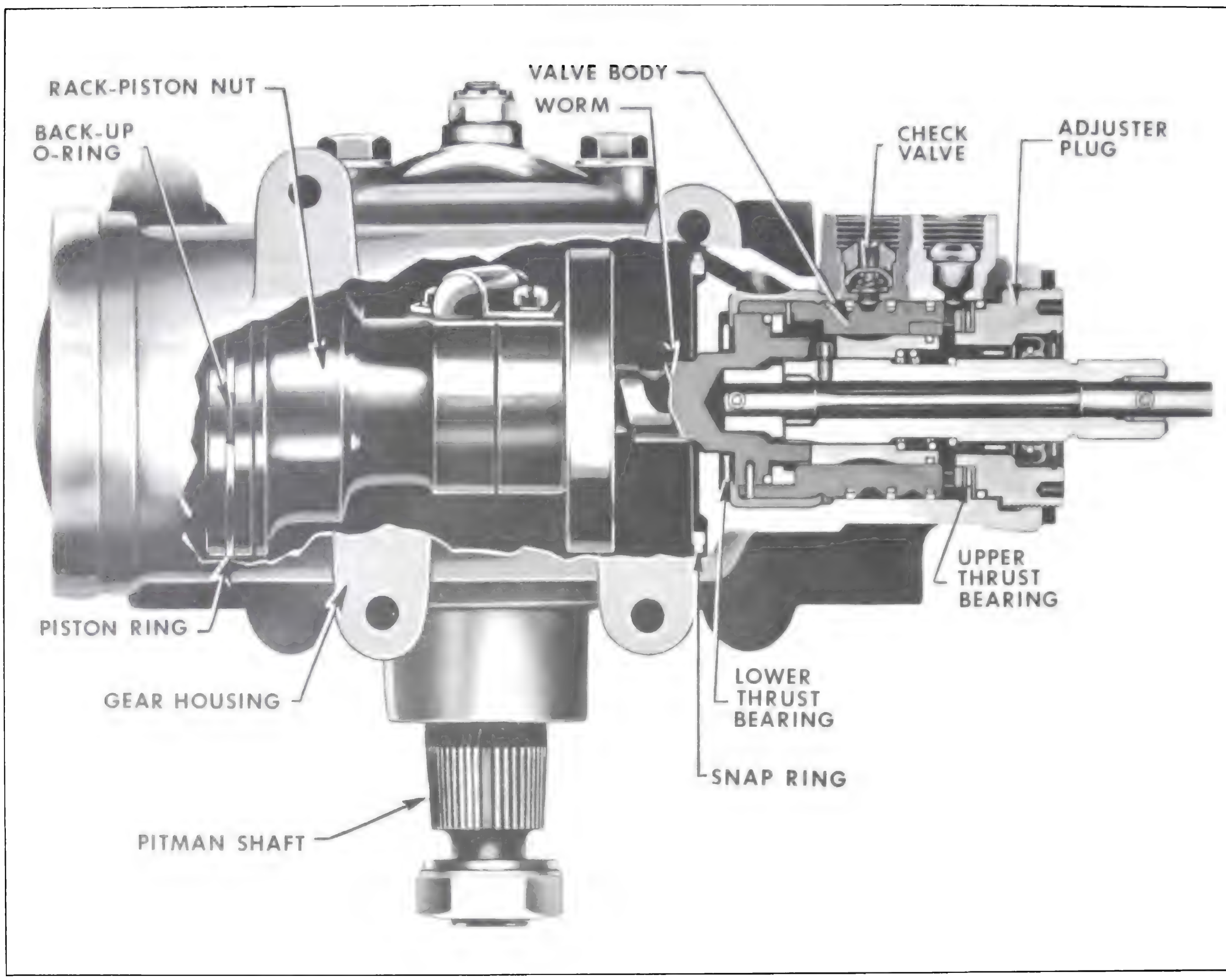


Figure 8-14—Power Steering Gear

Worm shaft radial loads are transmitted to the gear housing through the rack-piston nut. Worm end thrust is caused by the tendency of the worm to thread itself into or out of the rack-piston nut as the steering wheel is turned right or left. This end thrust is absorbed entirely by the upper and lower thrust bearings. The upper thrust bearing is located between the valve body and adjuster plug and the lower thrust bearing is located between the housing and upper end of worm.

The upper steering shaft is a separate shaft supported in the steering column jacket. Its upper end is supported by a bearing and its lower end by an adapter and ball bearing assembly.

The steering shaft is connected to the power steering gear through a flexible coupling which is riveted to the steering shaft flange. This flexible coupling helps absorb minor shocks and vibrations, dampens out hydraulic noises and gear assembly and the steering column jacket assembly.

The power steering gear identification number is stamped on the gear housing side cover. The first 3 digits show the day of the year (1 through 365) the gear was tested. The last digit shows the year (3 for 1963, etc.)

b. Rotary Valve Assembly

The rotary valve assembly controls the flow of oil from the pump to the proper side of the rack-piston nut when power assistance is required and cuts off this flow when power assistance is not required.

The rotary valve assembly is located in the upper section of the gear housing and consists of a stub shaft, a torsion bar, a valve body, a valve spool and a valve body cap. See Figure 8-15. The

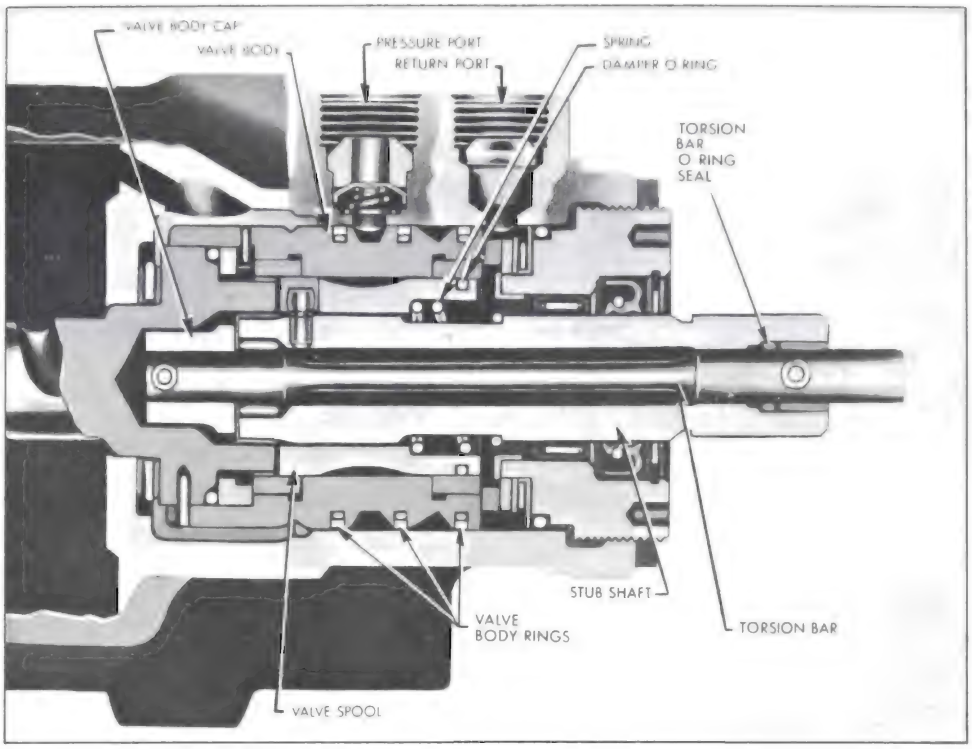


Figure 8-15—Rotary Valve Assembly

stub shaft is attached to the upper steering shaft through the flange assembly. The lower flange is splined to the stub shaft and is retained by a pinch bolt. The torsion bar is located in the center of the stub shaft. The valve spool is an open center valve and is positioned on the lower end of the stub shaft. The valve body encloses the valve spool. The valve body cap is located at the lower end of the valve body.

The valve body has two large oil grooves around its outside diameter. Each groove has four holes drilled into the inside diameter of the valve body. The lower groove is lined up with the pressure port in the gear housing. The upper groove is lined up with a drilled passage in the housing which directs oil to the right turn chamber in the housing, located at the lower end of the rack-piston nut. Three valve body Teflon rings provide leakproof seals for the oil grooves on the valve body. The inside diameter of the valve body has eight slots machined in it, four are connected to the pressure groove by the four drilled holes. See Figure 8-16. The other four slots, which are wider, are connected to the return port in the housing through the valve spool. Near the center of the valve body are four other drilled holes which are used to direct oil to a passage in the housing that opens to the left turn chamber. This chamber is located at the upper end of the rack-piston nut.

The valve spool which fits inside the valve body may have an outside diameter as low as only .0004 in. smaller than the inside diameter of the valve body. This close fit allows very little, if any, oil flow between the two surfaces. The valve spool has four holes drilled near the upper end of it which are in line with the four return slots in the valve body. These holes allow oil to flow from the return slots in the valve body to the center of the spool and on to return port in the housing. The outside diameter of the spool has eight slots machined on it, four are for opening the right turn holes in the valve body to the pressure slots or to the return slots in the valve body. The other four slots on the spool serve the same function for the left turn holes in the valve body.

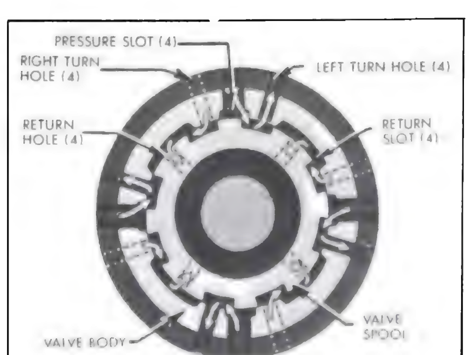


Figure 8-16—Upper End View of Rotary Valve - Left Turn

Basically the rotary valve assembly is divided into two separate assemblies which are fastened together by the torsion bar. To completely understand how the rotary valve functions, it must be known what parts are firmly attached together. Starting with the stub shaft which is fastened to the steering wheel through the upper steering shaft, the first assembly consists of the stub shaft, valve spool and upper end of the torsion bar. A pin on the outside diameter of the stub shaft retains the valve spool to it and a pin at the upper end of the stub shaft attaches the upper end of the torsion bar and shaft together. See Figure 8-17.

The other assembly which is connected to the front wheels of the car through linkage, pitman shaft and rack-piston nut, consists of the worm, valve body, valve body cap and lower end of the torsion bar.

The worm is attached to the valve body by a pin located at the upper end of the worm. A pin on the inside diameter of the valve body fastens the valve body cap to the valve body. To complete this assembly, a pin attaches the valve body cap to the lower end of the torsion bar.

When there is resistance to turning between the roadbed and the wheels of the car, the parts attached to the worm will also resist turning. Thus, when the steering wheel is turned by the driver, the torsion bar will deflect and allow the stub shaft and valve spool to rotate with the steering wheel. When this occurs, the relationship between the valve spool and valve body is changed and oil flow is directed by the slots on the valve spool through the holes in the valve body to the proper side of the rack-piston nut to assist the driver. The torsion bar deflection is limited to a predetermined amount. The upper end of the worm has two tangs which fit through slots in the valve body cap and into two slots in the end of the stub shaft. In case of a power mechanism failure, the stub shaft will contact the tangs of the worm and steering will be manual.

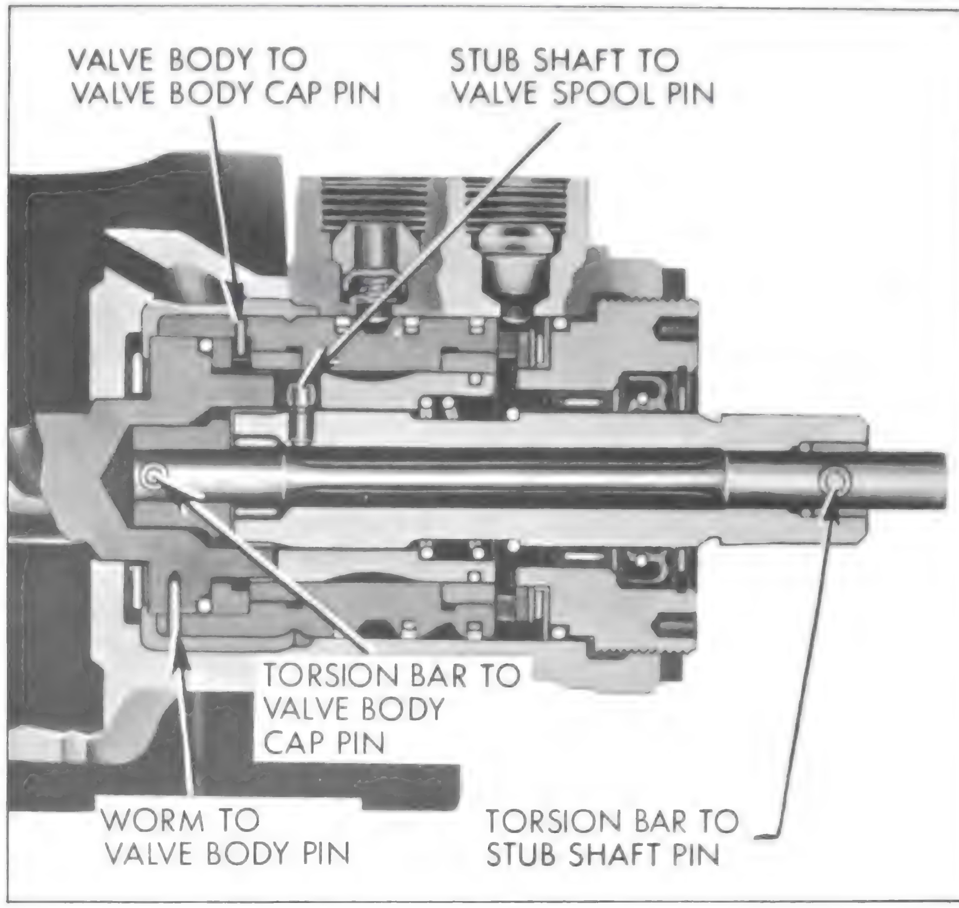


Figure 8-17—Attaching Pins for Valve Parts

c. Oil Pump and Hoses

The oil pump, which is mounted on the engine in position to be driven by a belt from the crankshaft balancer, converts some engine power into oil pressure which is used against the rack-piston nut to rotate the pitman shaft.

The pump reservoir encloses the pump housing and provides a reserve supply of oil to assure complete filling of the hydraulic system. See Figure 8-18. The reservoir cap is vented which permits escape of any air that may be introduced into the system during assembly of the various units and maintains atmospheric pressure in the reservoir.

The pump housing encloses the flow control valve and the rotor assembly. The flow control valve and spring are retained in pump housing by the pressure union. See Figure 8-19. This allows servicing the flow control valve without removing pump from the engine. Inside the flow control valve is the pressure relief valve. Also in the end of the flow control valve is a filter screen which filters the oil that enters this valve. The pressure union which is the pump outlet, contains the pump exit hole and an orifice.

The rotor assembly consists of a drive shaft, a thrust plate, a rotor with ten vanes, a pump ring and a pressure plate. Oil enters the rotor section of the housing through a reservoir hole in housing which is open to the surrounding reservoir.

The rotor is loosely splined to the end of the drive shaft, is located adjacent to the face of the thrust plate and is enclosed by the pump ring. The rotor has a pressed-in sleeve which fits through the thrust plate and keeps the rotor in alignment. The rotor vanes slide radially outward to contact the hardened and ground inside cam surface of the ring. See Figure 8-20.

As the shaft and rotor rotate, centrifugal force and fluid pressure against the inner ends cause the vanes to follow the cam contour of the ring. The cam surface is so shaped that two opposite pumping chambers are formed which cause a complete pumping cycle to occur every 180 degrees of rotation of the rotor. The pump ring has two crossover passages drilled in it which transfers oil from the thrust plate into a discharge cavity located at the rear of the pressure plate.

When the engine is started, each pumping chamber picks up oil from two openings, one between the pressure plate and ring and the other between the thrust plate and ring. See Figure 8-18. The oil is then propelled by the decreasing pockets in each pumping chamber into the discharge cavity through

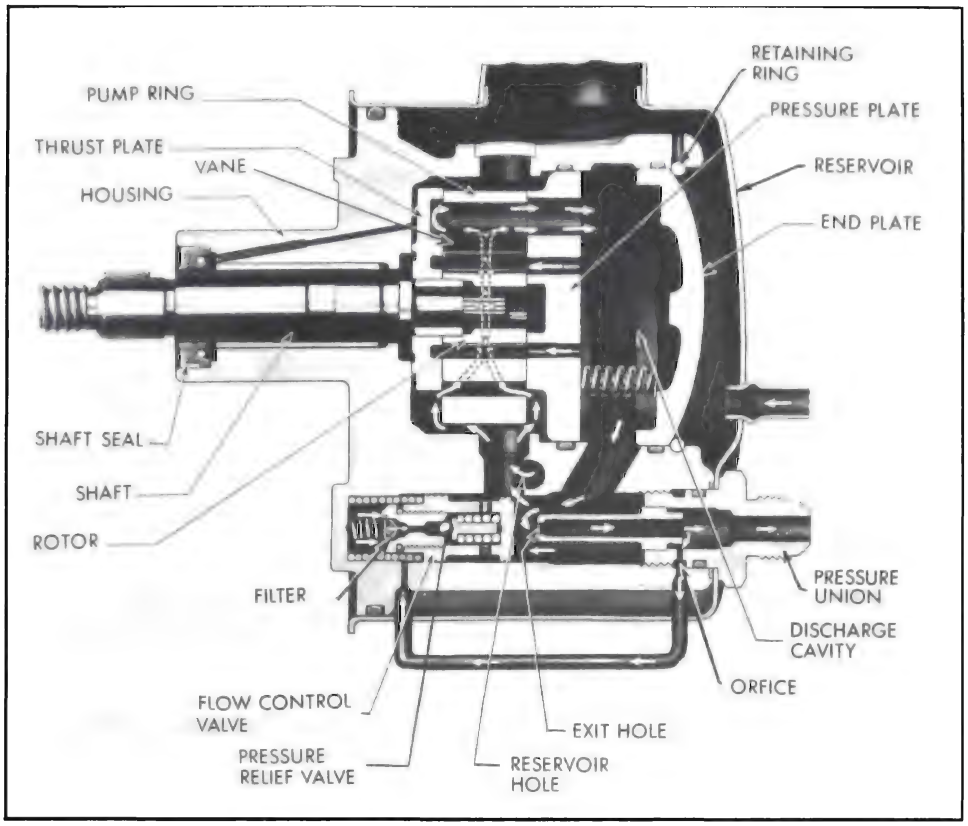


Figure 8-18—Oil Flow in Pump

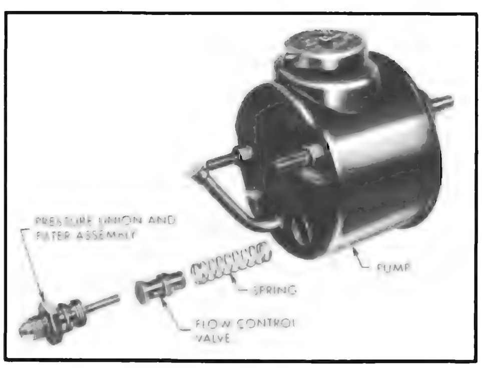


Figure 8-19—Flow Control Valve Installation

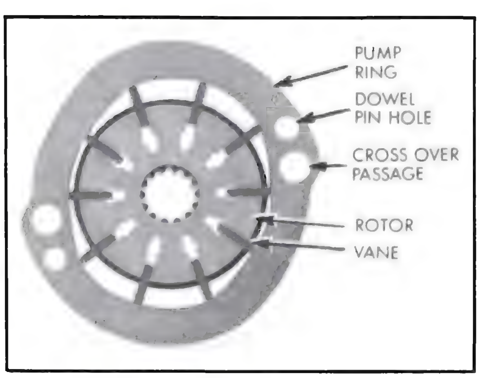


Figure 8-20—Pump Ring and Rotor

an opening in the pressure plate and an opening in the thrust plate which is connected to the cross-over passage in the ring. The oil flows from the discharge cavity into a passage which is open to the rear of the flow control valve and to the exit hole in one end of the pressure union. A certain quantity of oil flows through the outlet end of pressure union and on to the steering gear rotary valve assembly. Some oil flows through the orifice in the pressure union and into a passage in pump housing which directs oil into the spring chamber located in front of the flow control valve. Pressure in the discharge cavity is always greater than the pressure of the oil that has passed through the exit hole in the pressure union.

The flow control valve regulates the opening of a by-pass passage through which oil may be returned back to the suction and reservoir section of the pump.

When the pump is running without demand for steering pressure, pressure in the discharge cavity is great enough to push the flow control valve open against a spring load of approximately ten pounds. See Figure 8-21. The pressure in the spring chamber tends to close the valve but, since pressure in the discharge cavity is always greater than in the spring chamber, the valve is not closed. The movement of the valve is controlled by the spring tension and the difference in pressure on the front and rear side of the valve.

When power steering is demanded and the steering gear rotary valve restricts free circulation of oil as described later (par. 8-10), the pump pressure builds up rapidly. As the pressure increases in the discharge cavity it also increases in the spring chamber and in turn additional pressure is required to move the flow control valve to open the by-pass passage. The maximum amount of build-up of pressure by the pump depends on the amount of restriction through the gear which is controlled by the rotary valve. When power assistance is no longer required, the restriction through the gear is reduced to a predetermined minimum. With a small amount of restriction through the gear, the

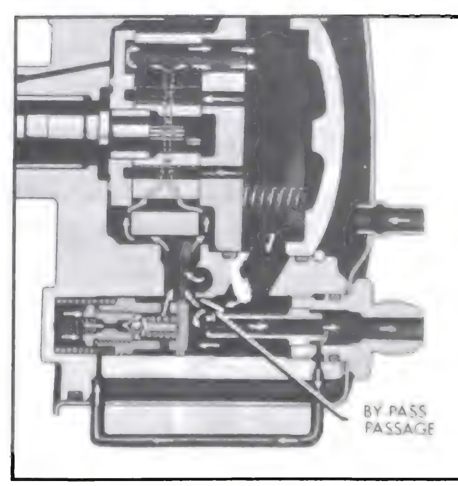


Figure 8-21—Flow Control Valve Operation

pressure in the spring chamber drops to a minimum value. Thus, the pressure in the discharge cavity also is reduced as this pressure is governed by the spring tension and the oil pressure present in the spring chamber of the pump.

If pump output pressure reaches 1100 to 1200 psi, the increased pressure in the spring chamber forces a pressure relief valve open and oil escapes from the spring chamber into the by-pass hole around the pressure relief valve ball. See Figure 8-21.

As oil pressure is relieved in the spring chamber, the high pressure in the pump discharge cavity overcomes the spring load to open the flow control valve. Because outlet pressure has to pass through an orifice to get into the spring chamber, the pressure in the spring chamber drops below outlet pressure for a fraction of a second. This allows the flow control valve to be open enough to lower line pressure to a safe level immediately. Oil is then pumped into the by-pass passage until the line pressure opposing the pump drops below the relief valve setting, permitting this valve to close. The flow control valve then resumes normal operation.

The flow control valve starts to open at 300-400 RPM of pump and is functioning when the pump is running 465 RPM (400 RPM of engine). The minimum flow a new pump must produce is 1.75 gal. per minute at 465 pump RPM against a pressure of 700 psi. The flow plunger permits a maximum flow of 2.3 gal. per minute at 1500 RPM against a pressure of 50 psi. The pressure relief valve is set for 1100 to 1200 psi.

The power steering pump identification number is stamped on the left side of the reservoir below filler neck. The first 3 digits show the day of the year (1 through 365) the pump was tested. Next is a letter for manufacturer identification (S for Saginaw). The last digit shows the year (3 for 1963, etc.).

A pressure hose connects the pressure union in the pump to the rotary valve in the steering gear housing and a return hose connects the rotary valve to the pump reservoir.

8-10 OPERATION OF POWER STEERING GEAR

a. Neutral or Straight-Ahead

Figure 8-22 shows the rotary valve in the neutral or straight-

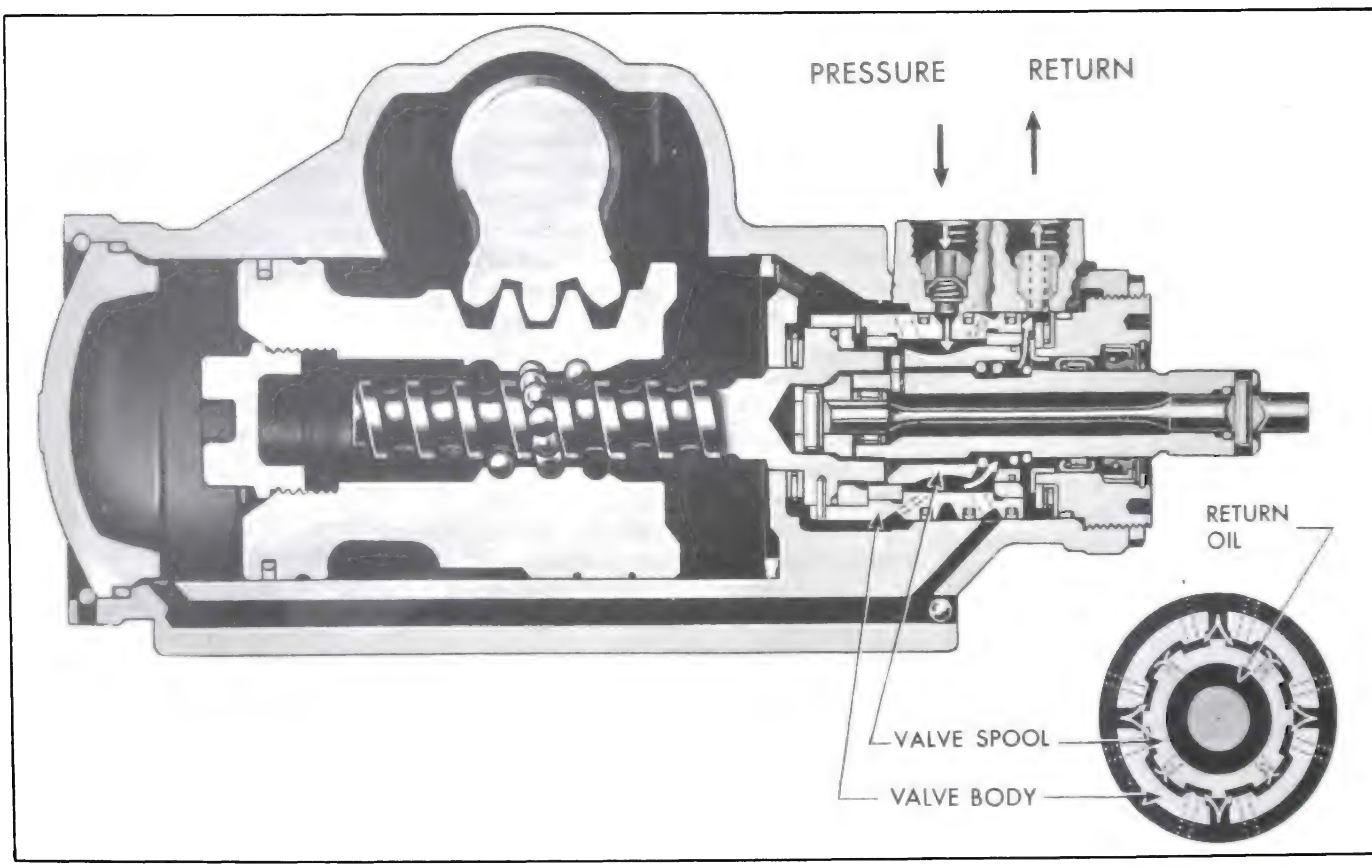


Figure 8-22—Oil Flow—Straight-Ahead

ahead position. Oil flows from the pump into the pressure port of the gear, through the open center valve spool and back to the pump reservoir through the return port. The slots on the valve spool are so positioned in the valve body that the oil entering through the pressure port is directed to the return slots in the valve body, then through the center of the spool which is open to the return port. There is no flow to either side of the rack-piston nut, but each side is full of oil at all times. In the straight-ahead position the pressure on both sides is equal. The oil acts as a cushion that absorbs road shocks so they are not transferred to the steering wheel, thus giving safer and more effortless driving. In addition, this oil lubricates all the internal components of the gear.

All passages in the gear are open in the straight-ahead position and the valve remains in this position at all times except when effort applied to the steering wheel is more than one pound. The rotary valve's open center position design reduces pump losses to a minimum by allowing a minimum of restriction to oil flow in the straight-ahead position.

b. Right Turn

Figure 8-23 illustrates the operation of the gear when the steering wheel is turned to the right. Due to the resistance to turning between the front wheels and the roadbed, the torsion bar is deflected, changing the relationship between the slots in the valve spool and the slots in the valve body. The right turn slots on the valve spool are closed off from the return slots in the valve body and are opened more to the pressure slots. The left turn slots of the spool are closed off from the pressure slots and opened more to the return slots. This causes oil to flow into the right turn chamber of the housing and force the rack-piston nut upward. As the rack-piston nut moves upward, it applies turning effort to the pitman shaft.

The oil in the left turn chamber in the housing is simultaneously forced out through the valve and back to the pump reservoir. The higher the resistance to turning between the roadbed and the car wheels, the more the position of the valve spool is changed in relationship to the valve body and the higher the oil pressure on the lower end of the rack-piston nut. Since the amount of hydraulic pressure directed to the right

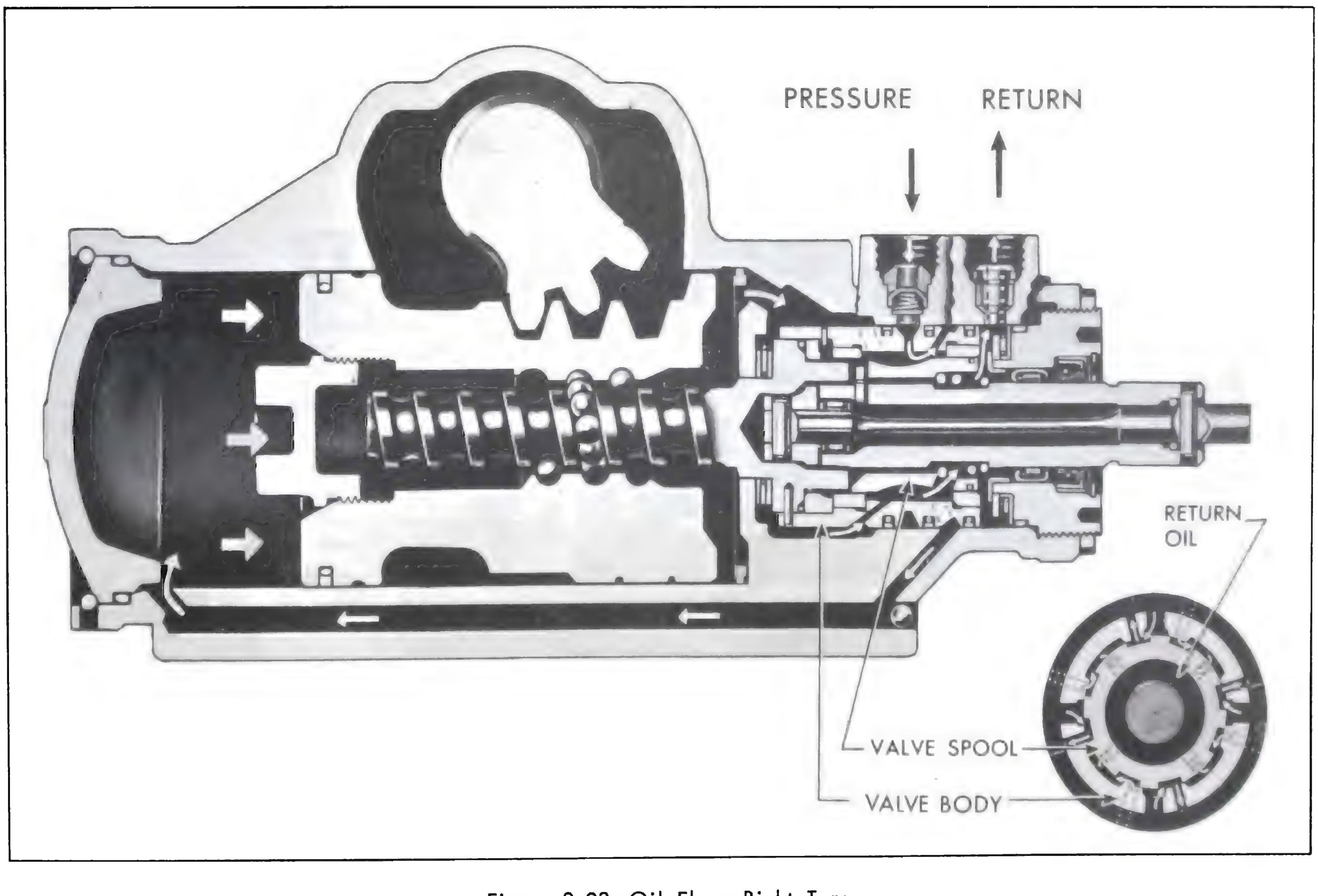


Figure 8-23—Oil Flow—Right Turn

turn chamber is dependent upon the resistance to turning, the driver is assured of the proper amount of smooth hydraulic assistance at all times.

The instant the driver stops applying steering effort to the steering wheel, the valve spool is moved back into its straight-ahead position in the valve body by the torsion bar.

When this happens, the oil pressure is again equal on both sides of the rack-piston nut and the steering geometry of the car causes the wheels to return to the straight-ahead position.

c. Left Turn

Figure 8-24 illustrates the operation of the gear when the steering wheel is turned to the left. The resistance to turning of the front wheels causes the torsion bar to deflect, changing the relationship between the valve spool slots and the valve body slots. The slots are reversed from the right turn position and change the flow of oil into the left turn chamber in the housing, moving the rack-piston nut downward. Thus, turning effort is applied to the pitman shaft. The oil in the right turn chamber is forced through the valve back to the reservoir. When the driver stops applying steering effort, the valve spool returns to its straight-ahead position.

d. Check Valve Poppet

The check valve is located in the pressure port of the housing under the connector. The valve consists of a poppet and a spring and its purpose is to reduce the possibility of steering wheel "kick-back". If when making a turn, the front tire hits a bump which forces it in a direction opposite the turn, the impact will be carried up to the rack-piston nut by the pitman shaft. If the force is great enough, the rack-piston nut will tend to move against the applied oil pressure and force oil back through the valve assembly and out through the pressure port where the poppet valve is now located. If the rack-piston moved in the opposite direction, the steering wheel would resist momentarily or would "kick-back". The poppet valve is designed to prevent the above action from occurring by trapping the oil inside the gear.

e. Steering Effort

During normal driving, the steering wheel effort will range from 1 to 2-1/4 pounds. The parking effort ranges from 2 to 3-1/4 pounds, depending upon the road

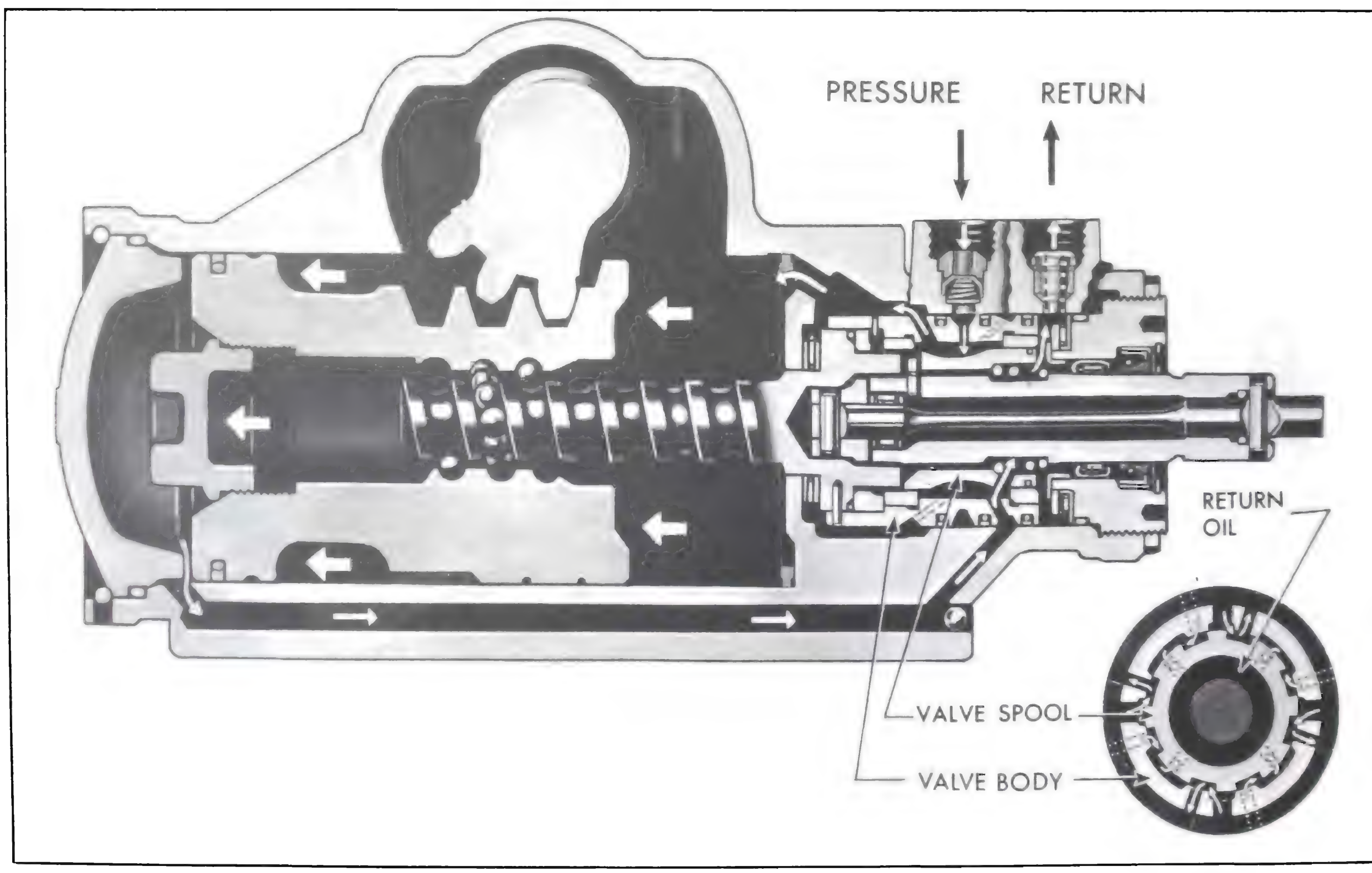


Figure 8-24—Oil Flow—Left Turn

conditions. Full hydraulic assist is obtained with approximately 3-1/4 pounds of effort at steering wheel rim. The more the turning resistance, the greater the pressure in the right or left turn chamber and the more effort the driver must apply to the steering wheel to turn the car. This proportional effort gives the driver the "feel of the road" at all times.

During normal driving conditions, the hydraulic oil pressure in the turn chambers should not exceed 125 psi. Pressure for cornering should not exceed 400 psi and parking pressure may range up to 1100-1200 psi depending upon the road surface.

8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP

NOTE: This paragraph covers only those causes of trouble which may be due to the hydraulic power mechanism. Causes which are due to the steering linkage and front suspension are the same as described for standard steering gear in paragraph 8-3.

COMPLAINT AND CAUSE	CORRECTION
a. HARD STEERING WHILE DRIVING	
1. Lower coupling flange rubbing against adjuster plug.	1. Loosen pinch bolt and assemble properly. There should be 1/16" clearance between plug and flange.
2. Steering adjustment tight.	2. Check adjustment by disconnecting pitman arm from gear.
3. Insufficient pressure build-up in gear power cylinder due to leak or faulty valve.	3. Replace defective parts.
4. Incorrect installation or operation of the gear check valve poppet.	4. Check operation of valve, paragraph 8-16, subparagraph C, Step 6.
b. POOR RETURN OF STEERING GEAR TO CENTER	
1. Lower coupling flange rubbing against adjuster plug.	1. Loosen pinch bolt and assembly properly.
2. Tighten pitman sector to rack-piston nut adjustment.	2. Adjust in car to specification.
3. Rack-piston nut to worm preload too tight.	3. Remove gear and replace balls as required.
4. Thrust bearing adjustment incorrect.	4. Adjust to specification.
5. Sticky valve spool.	5. Remove and clean valve. Replace rotary valve assembly if necessary.
c. PUMP INOPERATIVE OR POOR OR NO ASSIST	
NOTE: Refer to subparagraph i, Step 4, to determine if pump is at fault.	
1. Loose drive belt.	1. Tighten belt.
2. Low oil level.	2. Fill reservoir.
3. Air in the oil.	3. Locate source of air leak and correct.
4. Defective hoses.	4. Replace hose.
5. Flow control valve stuck open.	5. Remove burrs or dirt.
6. Loose screw in end of flow control valve.	6. Tighten.
7. Pressure plate not flat against ring.	7. Properly seat pressure plate against ring.

8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

COMPLAINT AND CAUSE	CORRECTION
c. PUMP INOPERATIVE OR POOR OR NO ASSIST (Cont'd)	
8. Extreme wear of pump ring.	8. Replace part.
9. Scored pressure plate, thrust and/or rotor.	9. Lap away light scoring. Replace heavily scored parts.
10. Vanes not installed properly.	10. Install properly.
11. Vanes sticking in rotor slots.	11. Free up by removing burrs or dirt.
12. Faulty flow control valve assembly.	12. Replace assembly.
13. "O" ring improperly installed on pressure union.	13. "O" ring must be in groove nearest outlet of union.
14. End plate improperly installed or seal damaged.	14. Install properly. Replace seal.
d. MOMENTARY INCREASE IN EFFORT WHEN TURNING WHEEL FAST TO THE RIGHT OR TO THE LEFT	
1. Air in system.	1. Bleed gear.
2. Low oil level in pump.	2. Check oil level in pump reservoir.
3. High internal leakage.	3. Replace rack-piston ring and back-up "O" ring, rack-piston nut end plug seal, and/or replace valve.
e. EXTERNAL OIL LEAKS	
NOTE: Wipe gear and pump thoroughly and make sure source of leakage is determined.	
1. Gear leaks.	
(a) Loose hose connections.	(a) Tighten.
(b) Damaged hose.	(b) Replace.
(c) Side cover "O" ring seal.	(c) Replace seal.
(d) Pitman shaft seal.	(d) Replace seals.
(e) Housing end plug "O" ring seal.	(e) Replace seal.
(f) Adjuster plug "O" ring seal.	(f) Replace seal.
(g) Torsion bar "O" ring seal (See Figure 8-15).	(g) Replace valve.
(h) Pitman shaft lash adjuster nut.	(h) Replace nut.
(i) Stub shaft seal.	(i) Replace seal.
2. Pump leaks.	
(a) Oil leaking at top of reservoir as it is too full.	(a) Remove oil to proper level.
(b) Oil leaking at top of reservoir caused by air bubbles in oil.	(b) Locate source of air leak and correct.
(c) Reservoir "O" ring seal damaged or improperly installed.	(c) Replace "O" ring.

8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

COMPLAINT AND CAUSE	CORRECTION
e. EXTERNAL OIL LEAKS (Cont'd)	
(d) Pressure union or reservoir to housing bolt and stud not tightened sufficiently.	(d) Torque union and stud and bolt to 30 foot pounds.
(e) Pressure union or reservoir to housing bolt and stud cross threaded or damaged.	(e) Replace damaged parts.
(f) Defective pressure fitting seat on hose end.	(f) Replace hose.
(g) Damaged reservoir to housing or pressure union "O" ring seals.	(g) Replace seals.
(h) Defective shaft seal.	(h) Replace seal.
(i) Damaged shaft at seal area.	(i) Replace shaft.
(j) Leaks in metal parts. (Example: Drawing crack in reservoir.)	(j) Replace defective part.
f. NOISE	
1. Gear Noise (rattle or chuckle)	
(a) Loose "overcenter" adjustment. NOTE: A slight rattle may occur on turns because of the increased lash when off the "high point". This is normal and the lash must not be reduced below the specified limits to eliminate this slight rattle.	(a) Adjust to specification.
(b) Gear loose on frame.	(b) Tighten mounting bolts to 65 foot pounds.
2. Gear Noise ("hissing" sound).	
(a) A hissing noise is natural when steering wheel is at end of travel or when slowly turning at stand still.	(a) Do not replace valve unless "hiss" is extremely objectionable. Investigate clearance around safety drive rivet pins. Be sure there is no metal-to-metal contact around flexible coupling as this will transmit valve hiss to car.
3. Gear Noise (squawk when turning or when recovering from a turn).	
(a) Cut or worn dampener "O" ring on valve spool.	(a) Replace dampener "O" ring.

8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

COMPLAINT AND CAUSE	CORRECTION
f. NOISE (Cont'd)	
4. Pump Noise.	
(a) Loose belt.	(a) Tighten belt.
(b) Hoses touching other parts of car.	(b) Adjust hose positions.
(c) Low oil level.	(c) Fill reservoir.
(d) Air in the oil.	(d) Locate source of air leak and correct.
(e) Excessive back pressure caused by hoses or steering gear.	(e) Locate restriction and correct. With pressure gauge installed in pressure hose between pump and gear and engine running at 1500 RPM, oil warm, and no effort on the steering wheel, pressure should not exceed 125 psi. See Figure 8-25. Check operation of check valve poppet, paragraph 8-16, subparagraph c, Step 6.
(f) Scored pressure plate.	(f) Lap away light scoring. Replace heavily scored part.
(g) Vanes not installed properly.	(g) Install properly.
(h) Vanes sticking in rotor slots.	(h) Free up by removing burrs or dirt.
(i) Extreme wear of pump ring.	(i) Replace part.
(j) Face of thrust plate scored.	(j) Lap away light scoring. Replace heavily scored part.
(k) Scored rotor.	(k) Lap away light scoring. Replace heavily scored part.
(l) Defective flow control valve.	(l) Replace.
g. EXCESSIVE WHEEL KICKBACK OR LOOSE STEERING.	
1. Air in system.	1. Add oil to pump reservoir and bleed.
2. Excessive lash between pitman shaft sector and rack-piston.	2. Adjust to specification.
3. Loose thrust bearing adjustment.	3. Remove gear and adjust to specification.
4. Rack-piston nut to worm preload too low.	4. Remove rack-piston nut and worm, and change balls to obtain specified preload.
5. Incorrect installation or operation of the gear check valve poppet.	5. Check operation of valve, paragraph 8-16, subparagraph c, Step 6.
h. STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING	
Loose pump belt.	Adjust to specification.

8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

COMPLAINT AND CAUSE	CORRECTION
i. HARD STEERING WHEN PARKING	
1. Loose pump belt.	1. Adjust to specification.
2. Low oil level in reservoir.	2. Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage.
3. Steering gear adjustments tight.	3. Adjust to specification.
4. Insufficient oil pressure.	4. If all of the above checks do not reveal the cause of hard steering, make the following tests of oil pressure: (a) Disconnect the pressure line at oil pump. Attach pressure gauge to pump. Connect the hose to end of gauge where the valve is located. See Figure 8-25. (b) With engine at warm idle (525 RPM) and gauge valve open, note the oil pressure on the gauge while turning steering wheel from one extreme position to the other. Especially note the maximum pressure which can be built up with the wheel held in either right or left extreme position. CAUTION: Do not hold wheel in extreme position for an extended period of time because it will drastically increase the oil temperature and will cause undue wear on the oil pump. (c) With oil temperature between 150°F and 170°F, as measured with a thermometer in the reservoir, the maximum oil pressure should not be less than 1000 psi for satisfactory power steering operation. (d) If the maximum oil pressure is less than 1000 psi, it indicates trouble in the pump, oil hoses, steering gear, or a combination of these parts. To eliminate the hoses and gear, close the gauge valve and quickly test pressure of the pump only with the engine at warm idle, then open the valve to avoid increasing oil temperature. A minimum pressure of 1000 psi should be present with valve closed.

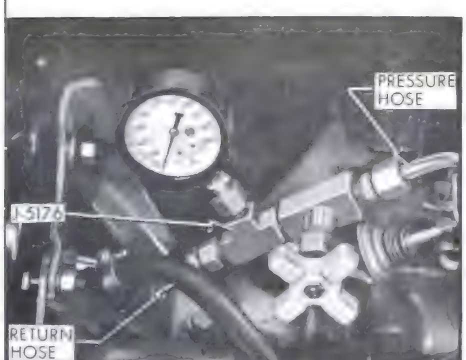


Figure 8-25—Pressure Gauge Installed

8-11 TROUBLE DIAGNOSIS—POWER STEERING GEAR AND PUMP (Cont'd)

COMPLAINT AND CAUSE	CORRECTION
i. HARD STEERING WHEN PARKING (Cont'd)	
	(e) Comparing the maximum pressure obtained in these two tests will indicate source of trouble as follows: Step (b) pressure low and Step (d) pressure normal indicates faulty external oil lines or steering gear. Step (b) and Step (d) pressures equally low indicates faulty oil pump.
5. Low oil pressure in gear caused by restriction in hoses.	
(a) Check for kinks in hoses.	(a) Remove kink.
(b) Foreign object stuck in hose.	(b) Remove hoses and remove restricting object or replace hose.
6. Low oil pressure due to steering gear.	
(a) Leakage at side cover "O" ring, housing end plug "O" ring, pitman shaft seals.	(a) Replace defective seals.
(b) Pressure loss in cylinder due to worn piston ring, damaged back-up "O" ring or scored housing bore.	(b) Remove gear from car for disassembly and inspection of rings and housing bore.
(c) Leakage at valve rings, valve body to worm seal, rack-piston end plug seal.	(c) Remove gear from car for disassembly and replace seals.
(d) Loose fit of spool in valve body or leaky valve body.	(d) Replace rotary valve assembly.
7. Incorrect installation or operation of the gear check poppet valve.	7. To determine if the poppet valve is installed and operating correctly, disconnect the pressure hose and install a pressure gauge between the hose and the pump. With the engine at warm idle (525 RPM) and no effort on the steering wheel, oil pressure should not exceed 60 psi with warm oil. If gauge indicates more than 60 psi the poppet valve should be checked for correct installation. Paragraph 8-16, subparagraph c., Step 6.
j. NO EFFORT REQUIRED TO TURN	
Broken torsion bar.	Replace rotary valve assembly.

8-12 REMOVAL AND INSTALLATION OF PITMAN SHAFT SEALS, STEERING GEAR AND OIL PUMP

a. Removal and Installation of Pitman Shaft Seals with Steering Gear in Car

If, upon inspection of the gear, it is found that oil leakage exists at the pitman shaft seals, the seals may often be replaced without removing gear assembly from car as follows:

1. Remove pitman nut and disconnect pitman arm from pitman shaft.

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman shaft to insure that seals will not be cut by splines during disassembly and assembly.

NOTE: Only one layer of tape should be used; an excessive amount of tape will not allow the seals to pass over it, due to the close tolerance between the seals and the pitman shaft.

3. Remove pitman shaft seal retaining ring with No. 3 Truarc pliers J-4245.

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Turn off engine.

NOTE: Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out.

5. Inspect seals for damage to rubber covering on O.D. If O.D. appears scored, inspect housing for burrs and remove before attempting new seal installation.

6. Clean the end of housing thoroughly so that dirt will not enter housing with the installation of the new seals.

7. Lubricate the seals thoroughly with petroleum jelly and install seals with Installer J-6219. Install the inner single lip seal first, then a back-up washer. See Figure 8-50. Drive seal in far enough to provide clearance for the other seal, back-up washer and retaining ring. Make sure that the inner seal does not bottom on the counter bore. Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring. Install retaining ring.

8. Fill pump reservoir to proper level. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks.

9. Remove tape and reinstall pitman arm.

b. Removal of Power Steering Gear

1. Place fender cover over left front fender.

2. Disconnect the pressure and return line hoses at the steering gear and elevate ends of hoses higher than pump to prevent oil from draining out of pump.

3. Remove pinch bolt from coupling lower flange. See Figure 8-26 or 8-27.

4. Jack up car and remove the pitman shaft nut, then remove the pitman arm using Puller J-5504. See Figure 8-28.

5. Loosen the three-frame-to-steering gear bolts at outside of frame and remove steering gear.

c. Installation of Steering Gear Assembly

1. Install the gear assembly by reversing the procedure for removal. See Figure 8-26 or 8-27 for tightening specifications. Torque pitman nut to 100 ft. lbs. Torque lower coupling pinch bolt to 30 ft. lbs. Be sure there is 1/16" clearance between adjuster plug and coupling.

2. Fill pump reservoir to correct level with automatic transmission oil.

3. Start engine and maintain oil level in reservoir while allowing engine to idle for at least three minutes before turning steering wheel. Then rotate steering wheel through its entire range slowly a few times with engine running. Recheck oil level and inspect for possible leaks.

NOTE: If air becomes trapped in the oil, the oil pump may be noisy until all air is out of oil. This may take some time since air trapped in oil does not bleed out rapidly.

d. Removal of Oil Pump

Refer to Figures 8-29 & 8-30.

It is not necessary to remove oil pump to service the flow control valve or to replace the shaft seal. The flow control valve is retained in pump housing by the pressure union. See Figure 8-19. Refer to paragraph 8-18 for replacing shaft seal without removing pump.

1. Remove pump pulley nut. Disconnect belt from pulley and remove pulley using a suitable puller. Do not hammer pulley off.

2. Disconnect return and pressure hoses from pump. Use shipping plugs and caps to cover the hose connector and union on pump

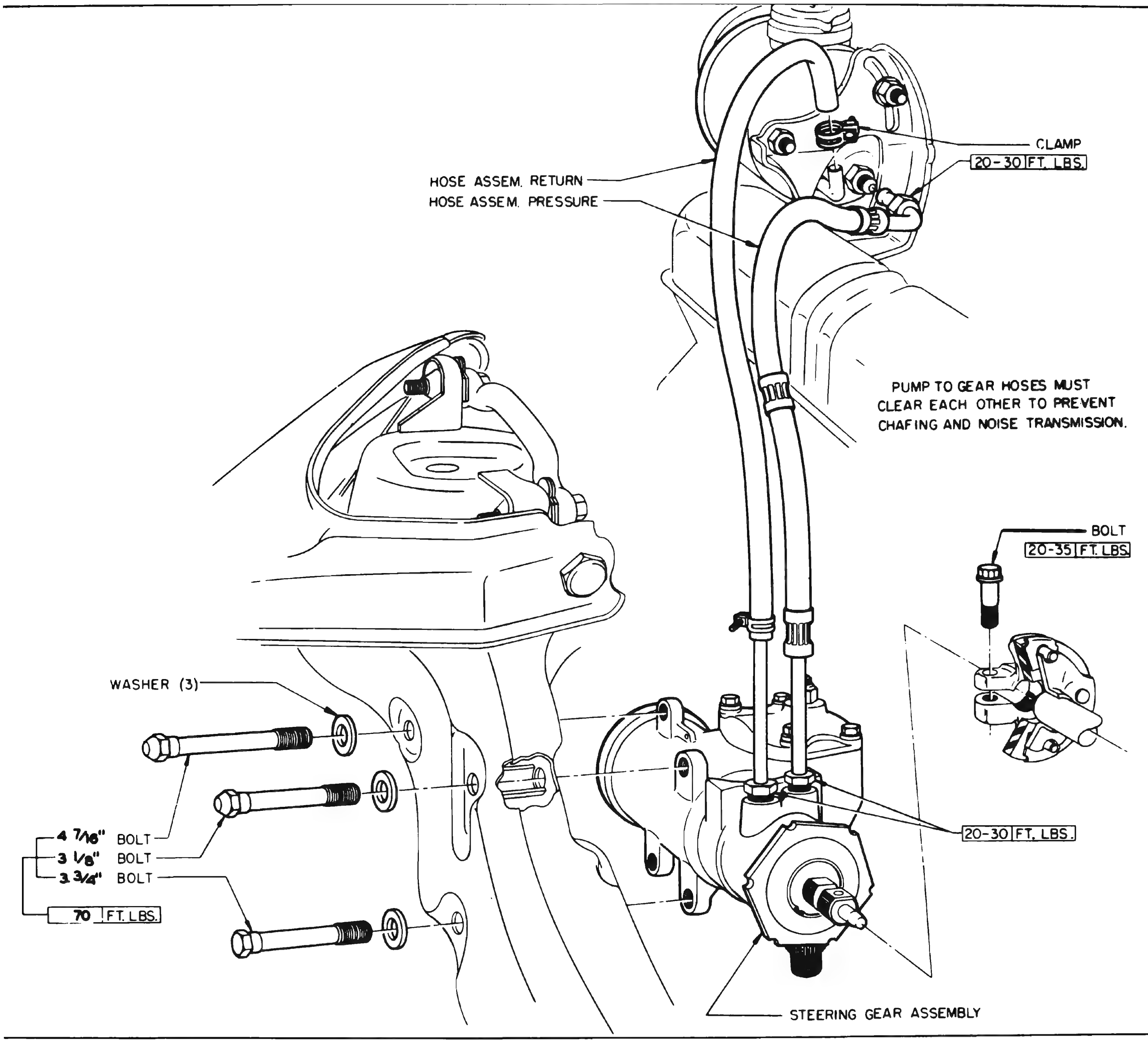


Figure 8-26—Power Steering Installation - 4400-4600-4800 Series

and open ends of the hoses to avoid entrance of dirt.

3. Remove the two nuts that attach pump to rear mounting bracket and remove the one bolt that attaches the rear bracket to the engine. Remove rear mounting bracket.

4. Complete pump removal by removing the two bolts that attach pump to the front mounting bracket. It is not necessary to remove front mounting bracket.

e. Installation and Bleeding of Oil Pump

1. Install the oil pump by reversing the procedure for removal.

2. When pump is reinstalled on engine, adjust drive belt tension. See Figure 2-39.

3. Fill pump reservoir to correct level with automatic transmission oil.

4. Start engine and maintain oil level in reservoir while allowing engine to idle for at least three minutes before turning steering wheel. Then rotate steering wheel through its entire range slowly a few times with engine running. Recheck oil level and inspect for possible leaks.

NOTE: If air becomes trapped in the oil, the oil pump may be noisy until all air is out of oil. This may take some time since air

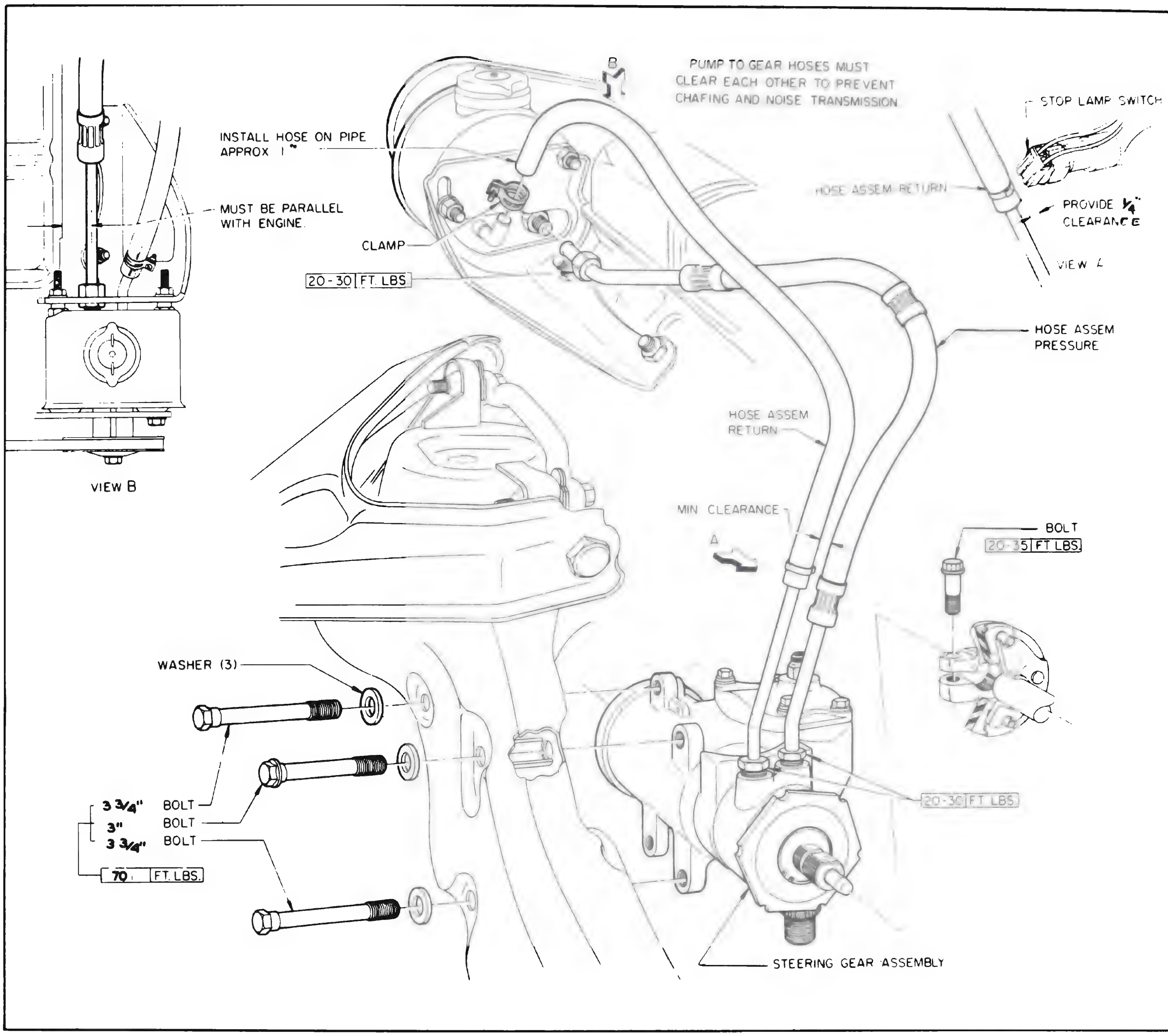


Figure 8-27—Power Steering Installation - 4700 Series

trapped in oil does not bleed out rapidly.

8-13 ADJUSTMENT OF POWER STEERING GEAR

a. Adjustment of Power Steering Gear in Car

IMPORTANT: Thrust bearing preload and worm to rack piston nut ball preload have little effect on handling. The most important gear adjustment affecting handling is the pitman shaft "overcenter" preload. The "overcenter" adjustment is made without removing gear from car, thus on handling complaints this adjustment should be checked and corrected and car road tested before removing gear to change thrust bearing preload or ball preload.

1. Remove pitman arm from pitman shaft. See Figure 8-28.

NOTE: Never attempt to adjust steering gear with pitman arm connected to pitman shaft.

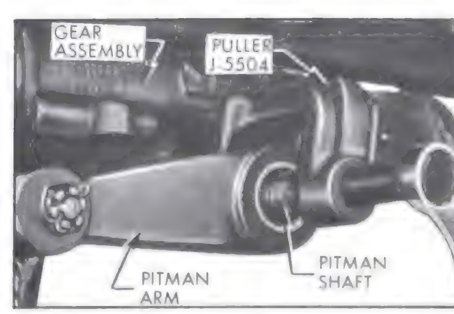


Figure 8-28—Removing Pitman Arm from Pitman Shaft

2. Remove cap from steering wheel. See Figure 8-6.

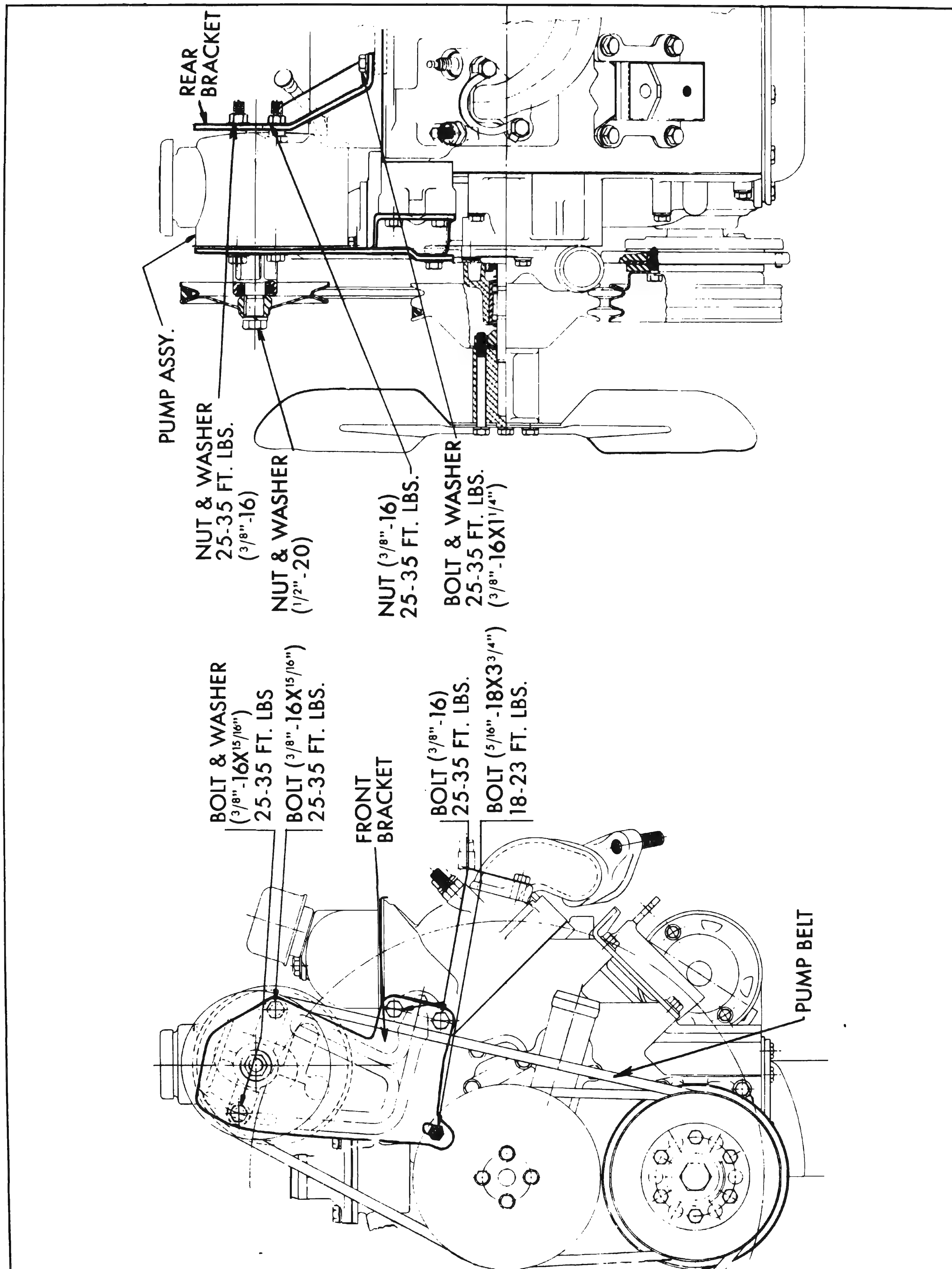


Figure 8-29—Power Steering Pump Installation - 4400-4600-4800 Series

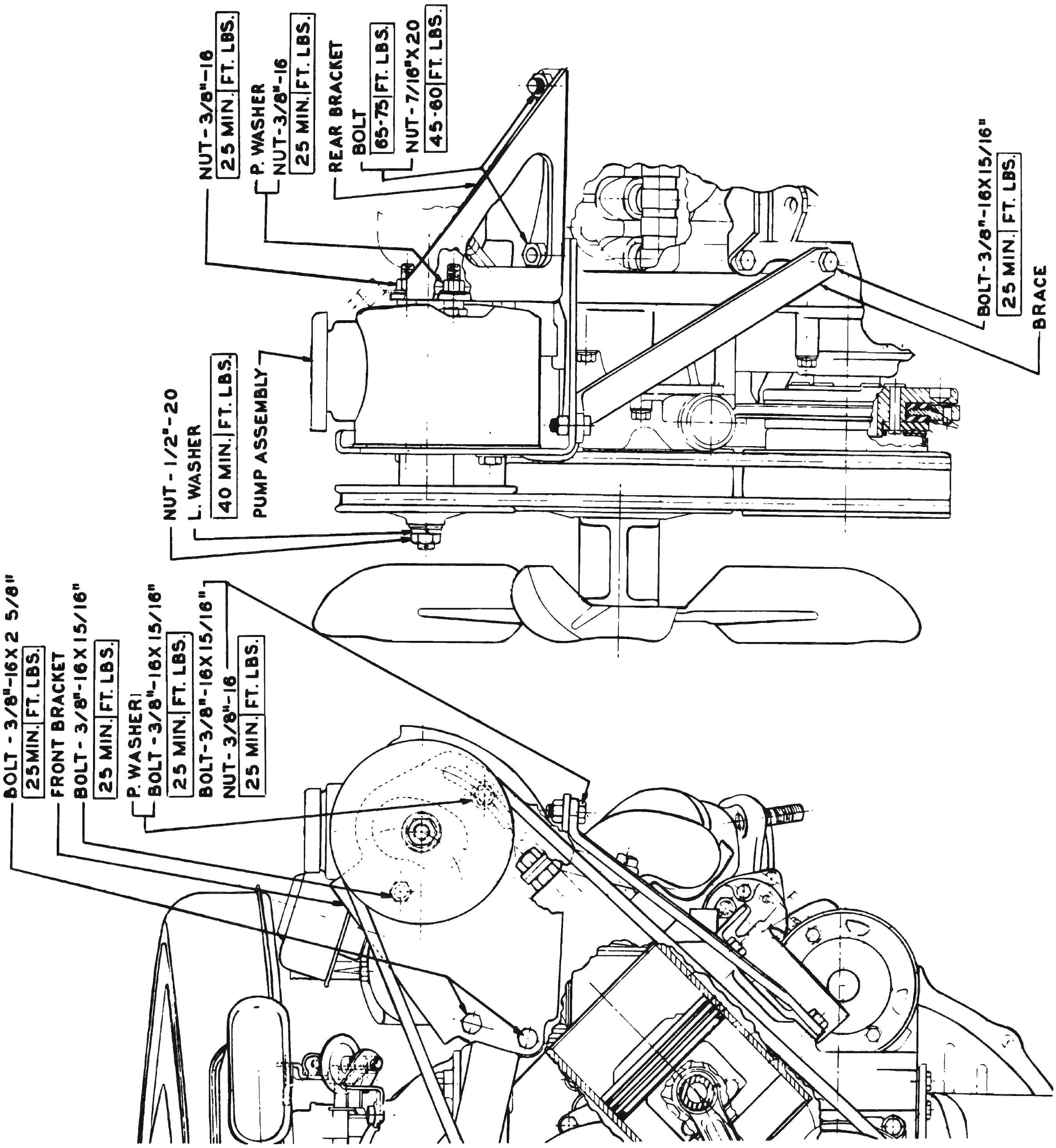


Figure 8-30—Power Steering Pump Installation - 4700 Series

3. Turn steering wheel slowly through its full travel to check for binding, tight spots or uneven action.

NOTE: If a spring scale is used to check adjustments, follow specifications listed in paragraph 8-8 (b).

4. Turn steering wheel to extreme right or left position. Attach Torque Wrench J-5853 to steering wheel retaining nut and check the torque required to turn the wheel steadily in the range where lash normally exists between rack-piston nut and pitman shaft sector. See Figure 8-31. The lash range exists for one-eighth turn of steering wheel from either extreme position.

5. The reading on the torque wrench should be between 1 and 11 inch pounds, which would indicate normal preload at the thrust bearing and drag at the valve assembly.

6. Turn steering wheel 1/2 to 3/4 of a turn off "high-point" (center position) of gear. Worm to rack ball preload is checked with gear in this position.

NOTE: It is not necessary to back off pitman shaft lash adjuster to check ball preload when gear is positioned as instructed in Step 6.

7. Check the torque required to turn the wheel. The reading should be 1 to 5 inch pounds higher than reading recorded in Step 5 which would indicate normal ball preload between worm and rack-piston nut.

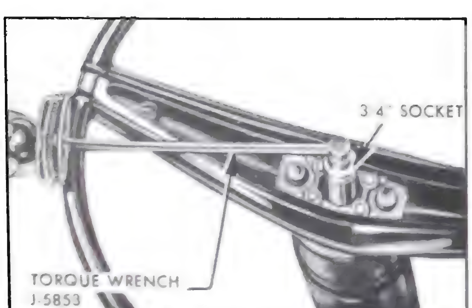


Figure 8-31—Checking Adjustments in Car

NOTE: The thrust bearing preload and ball preload readings should be close to the minimum specification on a gear that has been in use. On a new gear, these readings will be greater.

8. Check torque required to turn wheel through the gear "high-point" (center position). The reading should be 4 to 8 inch pounds higher than was obtained in Step 7. Adjust pitman shaft lash adjuster if necessary.

b. Adjustment of Power Steering Gear Out of Car

1. This adjustment is made when the gear is completely assembled and with gear on bench.

2. Loosen adjuster plug locknut and back off adjuster plug approximately 1/8 turn with adjustable Spanner Wrench J-7624. Attach Torque Wrench J-5853 with 3/4 inch 12 point socket to stub shaft and turn shaft to approximately 1/2 turn from either extreme. Slowly rotate wrench in an arc approximately 60° (1/6 turn) in both directions several times to measure valve drag and record highest reading. See Figure 8-32. Then tighten adjuster plug until thrust bearing preload is 1 to 3 inch pounds in excess of drag measured with adjuster plug backed out. Total of thrust bearing preload and valve drag should not exceed 11 inch pounds.

3. Turn stub shaft 1/2 to 3/4 of a turn off "high-point" (center position) of gear. Worm to rack ball preload is checked with gear in this position.

NOTE: It is not necessary to back off pitman shaft lash adjuster to check ball preload when gear is positioned as instructed in Step 4.

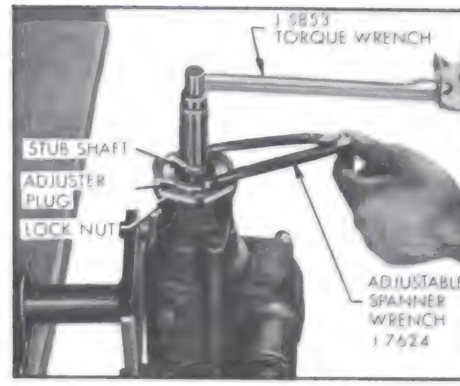


Figure 8-32—Adjusting Thrust Bearing Preload

4. Check the pull required to turn stub shaft. The reading should be 1 to 5 inch pounds higher than total reading obtained in Step 3. If reading is not within specification it will be necessary to readjust ball preload between worm and rack-piston nut.

5. If readings are within specifications, check and adjust if necessary, pitman shaft "over-center" adjustment. Reading on torque wrench should be 4 to 8 inch pounds higher than was obtained in Step 5. See Figure 8-33. This reading is taken when rotating stub shaft through "high-point" range with lash adjuster nut tight.

8-14 DISASSEMBLY, INSPECTION AND ASSEMBLY OF ADJUSTER PLUG ASSEMBLY AND ROTARY VALVE ASSEMBLY

a. Removal of Adjuster Plug Assembly and Rotary Valve Assembly

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Place gear assembly in vise.

Figure 8-33—Pitman Shaft Over Center Adjustment

3. Loosen adjuster plug lock nut with Punch and remove adjuster plug using adjustable Spanner Wrench, J-7624.

4. Remove rotary valve assembly from gear by grasping stub shaft and pulling out.

NOTE: If it is only necessary to service the rotary valve assembly, proceed wih subparagraph d below.

b. Disassembly of Adjuster Plug Assembly

1. Remove the upper thrust bearing retainer with a screwdriver, being careful not to damage the needle bearing bore. See Figure 8-35. Discard retainer. Remove thrust bearing spacer, upper thrust bearing and thrust bearing races.

2. Remove adjuster plug "O" ring and discard.

3. Remove stub shaft seal retaining ring using No. 3 Truarc Pliers J-4245 and remove and discard dust seal. See Figure 8-36.

4. Remove stub shaft seal by prying out with screwdriver and discard.

5. Inspect needle bearing in adjuster plug and if rollers are broken or pitted, remove needle bearing by pressing from thrust bearing end using Tool J-6221 and discard bearing. See Figure 8-37.

6. Inspect thrust bearing spacer for cracks.

7. Inspect thrust bearing rollers and thrust bearing races for wear, pitting, scoring, cracking or brinelling. Replace any damaged parts.

c. Reassembly of Adjuster Plug Assembly

1. If needle bearing was removed because of damage, install new needle bearing from thrust bearing end of adjuster plug, by pressing against identification end of bearing using Tool J-6221. End of bearing must be flush with bottom surface of stub shaft seal bore.

2. Lubricate new stub shaft seal with automatic transmission oil and install seal with spring in seal toward adjuster plug using Tool J-5188. See Figure 8-38. Install seal only far enough in plug to provide clearance for dust seal and retaining ring. Place new dust seal with lip up in plug, then install retaining ring with No. 3 Truarc Pliers, J-4245.

3. Lubricate new adjuster plug "O" ring seal with petroleum jelly and install on adjuster plug. Assemble large O.D. thrust bearing race with internal flange up on adjuster plug, then thrust bearing, smaller thrust bearing race and thrust bearing spacer on adjuster plug. Install new thrust bearing retainer into needle bearing bore using punch, being careful not to damage spacer. See Figure 8-39. Radial location of dimples on retainer is not important. Thrust bearing assembly and spacer must be free to rotate and retainer must be completely below surface of spacer.

d. Disassembly of Rotary Valve Assembly

It is very uncommon to have to make any service repairs to the valve assembly with the possible exception of the valve spool dampener "O" ring seal. DO NOT disassemble the valve unless absolutely necessary since this may result in damaging the assembly. If the valve spool dampener "O" ring seal requires replacement, remove the valve spool only, replace the "O" ring and reinstall the spool immediately. DO NOT disassemble further.

CAUTION: Cleanliness of parts, tools and work area is of the utmost importance during servicing of the valve assembly.

1. Remove cap to worm "O" ring seal and discard.

2. Remove valve spool spring by prying on small coil with a small screwdriver to work spring onto bearing surface of stub shaft. Slide spring off shaft. Be very careful not to damage stub shaft surface.

3. Remove the valve spool by holding the valve assembly in one hand with the stub shaft pointing downward. Insert the end of a pencil or wood rod through the opening in the valve body cap and lightly push on the valve spool until it is far enough out of the valve body to be withdrawn. See Figure 8-40. Withdraw the spool with a steady rotating pull to prevent jamming. See Figure 8-41. If slight sticking occurs, make a

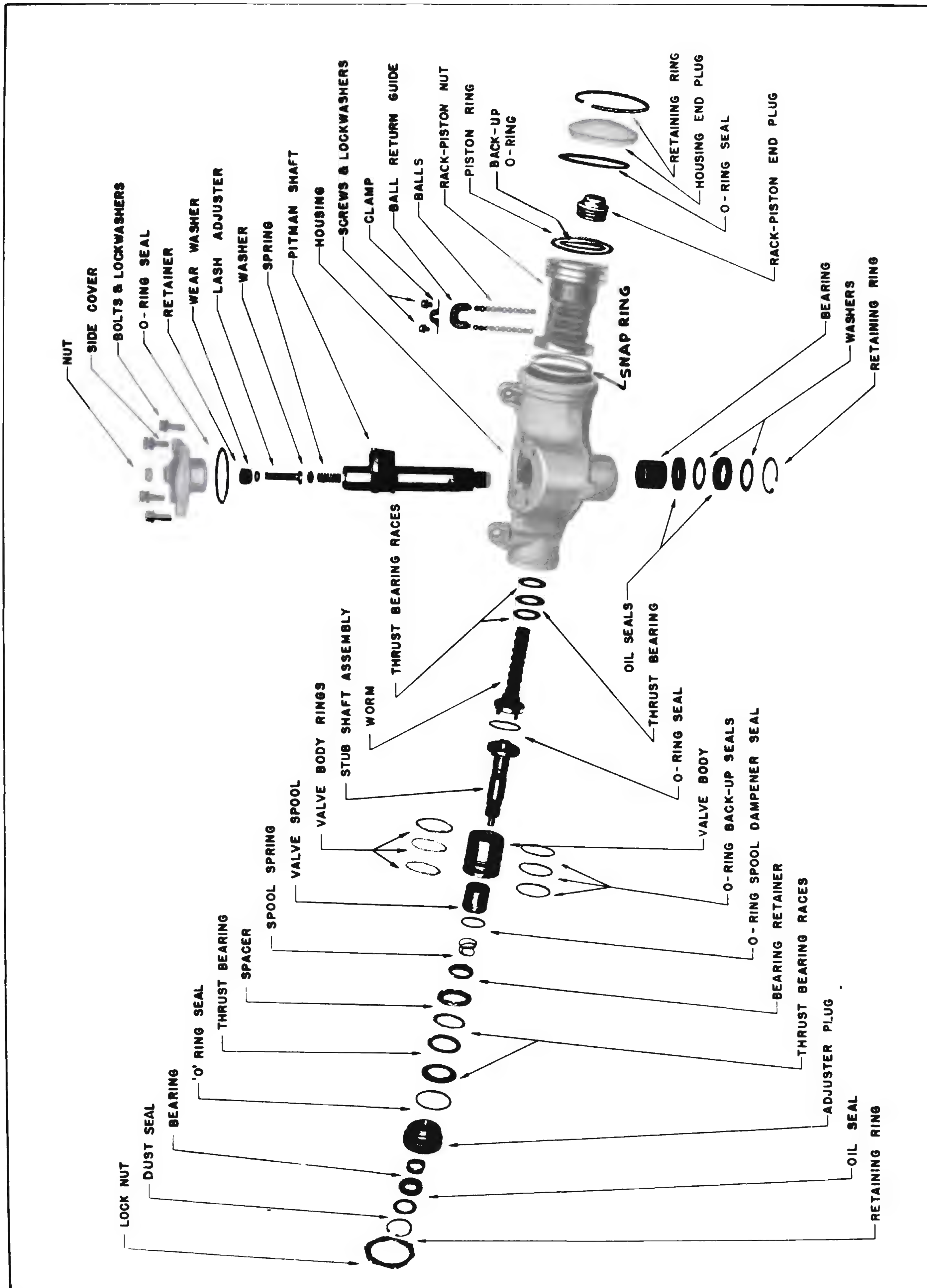


Figure 8-34—Exploded View of Power Steering Gear

Figure 8-35—Removing Upper Thrust Bearing Retainer

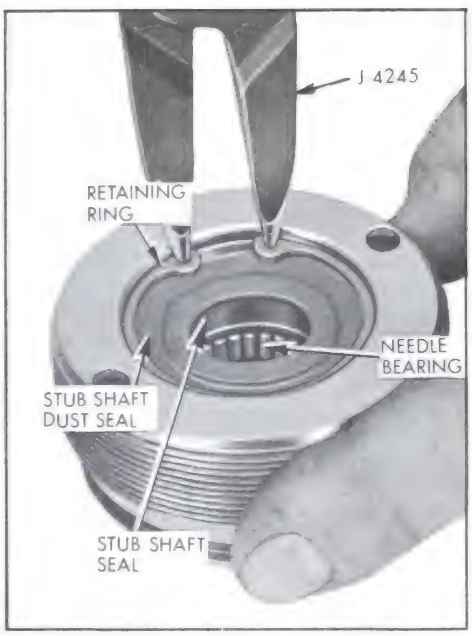


Figure 8-36—Removing Stub Shaft Seal Retaining Ring

gentle attempt to reverse the withdrawal procedure. If this does not free spool, it has become cocked in the valve body bore. Do not attempt to force the spool in or out if it becomes cocked, but continue with the following step.

CAUTION: The valve spool must be removed with extreme care. The clearance between the valve body and the spool may be as low

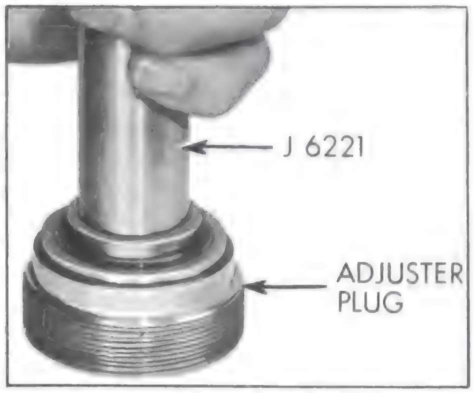


Figure 8-37—Removing Needle Bearing

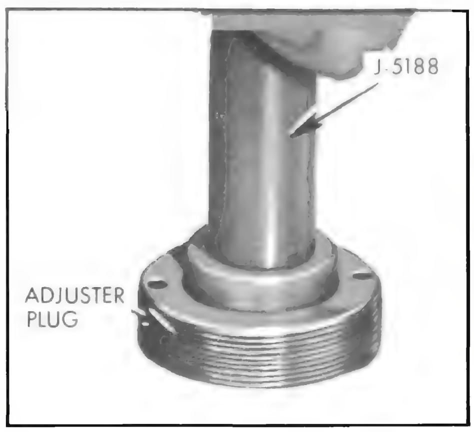


Figure 8-38—Installing Stub Shaft Seal

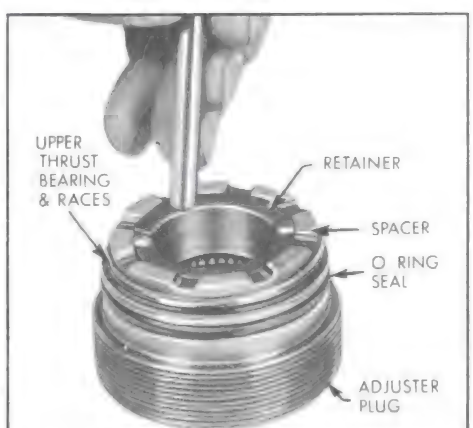


Figure 8-39—Installing Upper Thrust Bearing Retainer

as .0004 inch. The slightest cocking of the spool may jam it in the valve body.

4. Remove the stub shaft, torsion bar and cap assembly by holding the valve assembly with stub shaft downward as shown and rapping

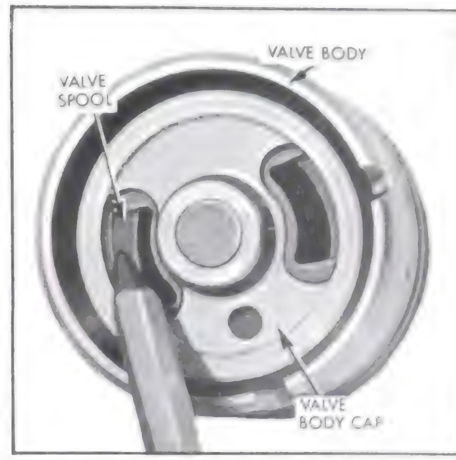


Figure 8-40—Separating Valve Spool From Valve Body

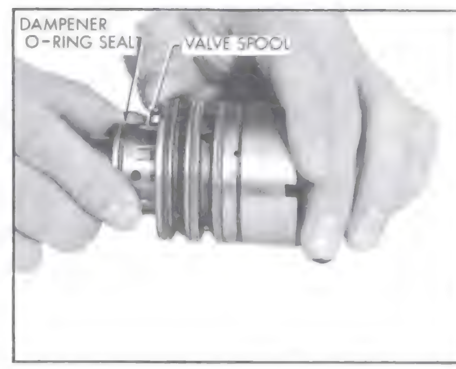


Figure 8-41—Withdrawing Valve From Valve Body

torsion bar lightly against workbench to dislodge the cap from the valve body to cap pin. See Figure 8-42. Complete the removal of the stub shaft torsion bar and cap assembly.

5. If the valve spool became cocked as described in Step 3 above, it can now be freed by visually determining in which direction it is cocked. Tap the spool lightly with a plastic or wood rod to align it and free it in the valve body bore. Do not tap spool with anything metallic.

6. Remove valve spool dampener "O" ring seal and discard.

7. If there is evidence of wear or leakage carefully cut and remove three valve body rings and three ring back-up "O" ring seals. Discard rings and seals.

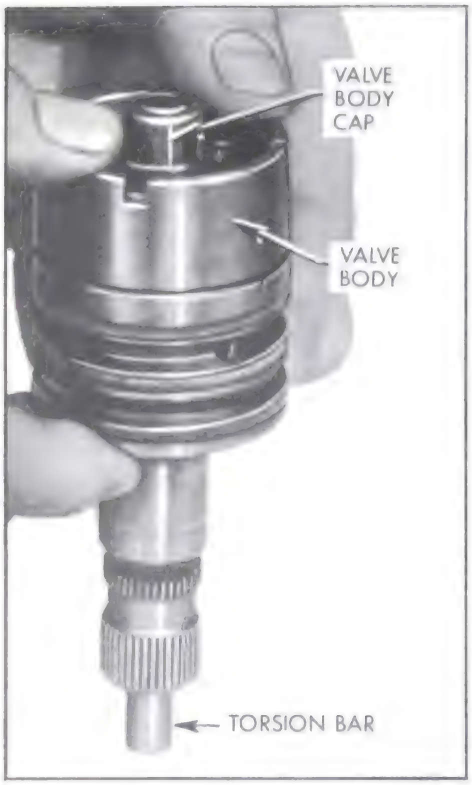


Figure 8-42—Removing Stub Shaft, Torsion Bar and Cap Assembly From Valve Body

e. Inspection of Rotary Valve Assembly

The rotary valve assembly is a precision unit with selectively fitted parts and is hydraulically balanced when assembled at the factory. Only those parts which are listed in parts book are replaceable and interchangeable. No other valve parts are individually interchangeable. If replacement of any non-serviceable valve part is necessary, the rotary valve assembly should be replaced.

1. If the valve assembly leaks externally between the torsion bar and stub shaft, the valve assembly should be replaced. The torsion bar "O" ring seal in the stub shaft is not serviced.

2. Inspect the pin in the valve body that engages the valve cap for being badly worn, cracked, or broken. If the pin is damaged the valve assembly should be replaced.

3. Inspect the smaller of the two grooves in the end of valve body. If it is worn badly the valve assembly should be replaced.

4. Inspect the valve spool drive pin in the stub shaft. If it is worn badly, cracked or broken the valve assembly should be replaced.

5. Examine the valve spool O.D. and the valve body I.D. for nicks, burrs or bad wear spots. If any are found, the valve assembly should be replaced. A slight polishing is normal on the valve surfaces.

6. Check the fit of the spool in the valve body. Lubricate the spool with automatic transmission oil and install it in the valve body without the dampener "O" ring seal on it. The spool should rotate smoothly without binding or catching. If spool does not rotate smoothly, the valve assembly should be replaced.

7. Measure the length of the valve spool spring. The free length should be approximately 3/4 to 7/8 inch. If it measures 11/16 inch or less, the spring should be replaced because this indicates that the spring has taken a set.

8. Examine the needle bearing surface on the stub shaft for being badly worn, brinelled or scored. If damaged, the valve assembly should be replaced.

f. Reassembly of Rotary Valve Assembly

CAUTION: All parts must be free and clear of dirt, chips, etc., before assembly and must be protected after assembly.

1. If removed from valve body, lubricate three new ring back-up "O" ring seals in automatic transmission oil and assemble in the three ring grooves on the valve body. Assembly three new valve body rings in the ring grooves over the "O" ring seals by carefully slipping over the valve body. See Figure 8-43.

NOTE: The valve body rings may appear loose or twisted in the grooves, but the heat of the oil during operation after assembly will cause them to straighten.

2. Lubricate a new valve dampener "O" ring seal in automatic transmission oil and install in valve spool groove.

3. Assemble the stub shaft torsion bar and cap assembly in the valve body, aligning the groove in the valve cap with the pin in the valve body. See Figure 8-44. Tap lightly on the cap with a soft mallet until cap is against the shoulder in the valve body. Valve body pin must be in the cap groove. Hold these parts together during the rest of valve assembly.

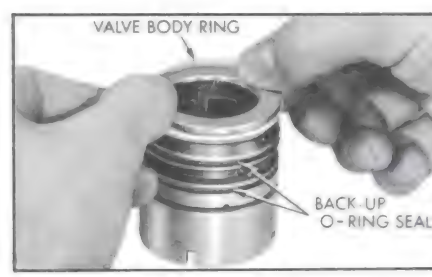


Figure 8-43—Installing Valve Body Rings

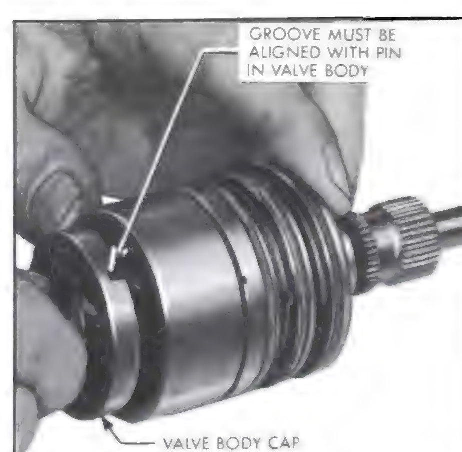


Figure 8-44—Assembling Stub Shaft, Torsion Bar and Cap Assembly in Valve Body

4. Lubricate valve spool with automatic transmission oil. With notch in spool toward valve body, slide the spool over the stub shaft. Align the notch on the valve spool with the spool drive pin on the stub shaft and carefully engage the spool in the valve body bore. Push the spool evenly and slowly with a slight rotating motion until spool reaches drive pin. Rotate spool slowly with pressure until the notch engages the pin. Before pushing the spool completely in, make sure dampener "O" ring seal is evenly distributed in the spool groove.

Complete the spool assembly slowly with care so the "O" ring seal is not damaged.

CAUTION: Because the clearance between the spool and valve body is very small, extreme care must be taken when assembling these parts.

5. Place Seal Protector J-6222 over stub shaft and slide valve spool spring over stub shaft with smaller diameter coil going over end of shaft last. See Figure 8-45. Work spring on shaft with a small screwdriver until small coil of spring is seated in the stub shaft groove. Be careful not to damage surface of shaft.

NOTE: Spring must be seated properly in groove in stub shaft.

6. Lubricate a new cap to worm "O" ring seal in automatic transmission oil and install in valve body.

NOTE: If during the assembly of the valve, the stub shaft and valve cap were allowed to slip out of engagement with the valve body pin, the spool will be permitted to enter the valve body too far. The spool dampener "O" ring seal will expand into the valve body oil slots and will prevent withdrawal of the spool. If this has occurred, attempt to withdraw spool with a slight pull and much rotary motion. If this does not free the spool make sure spool is free to rotate and place valve body on a flat surface with notched end up. Tap spool with wooden or plastic rod until "O" ring seal is cut and spool can be removed. Install new dampener "O" ring seal and proceed with assembly as before starting with Step 2 above.

g. Installation of Rotary Valve Assembly and Adjuster Plug Assembly

1. Align the narrow pin slot on the valve body with the valve body drive pin on the worm. Insert the valve assembly into the gear housing by pressing against the valve body with the finger tips. Do not press on stub shaft or torsion bar. See Figure 8-46. The return hole in the gear housing should be fully visible when valve is assembled properly. See Figure 8-47.

CAUTION: Do not push against the stub shaft during assembly as this may cause the stub shaft and cap to pull out of the valve body, allowing the spool dampener "O" ring seal to slip into valve body oil grooves. Be sure valve is properly seated before installing adjuster plug assembly.

2. Place Seal Protector J-6222 over end of stub shaft. Install adjuster plug assembly in gear housing snugly with adjustable Spanner Wrench J-7624 then back plug off approximately 1/8 turn. Install adjuster plug lock nut if removed, but do not tighten.

3. Adjust the thrust bearing preload. Attach Torque Wrench J-5853 with a 3/4 inch socket to the stub shaft. Turn stub shaft to approximately 1/2 turn from either extreme. Slowly rotate wrench in an arc approximately 60° (1/6 turn) in both directions several times to measure valve drag. See Figure 8-32. Then tighten adjuster plug until thrust bearing preload is 1 to 3 inch pounds in excess of valve drag measured with adjuster plug backed out. Total of thrust bearing preload and drag should not exceed 11 inch pounds.

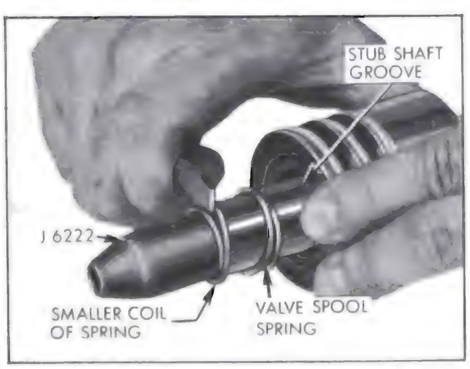


Figure 8-45—Installing Valve Spool Ring

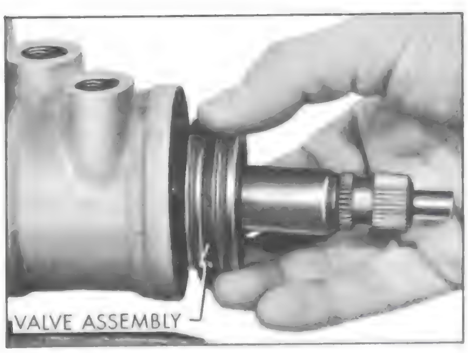


Figure 8-46—Inserting Valve Assembly in Housing

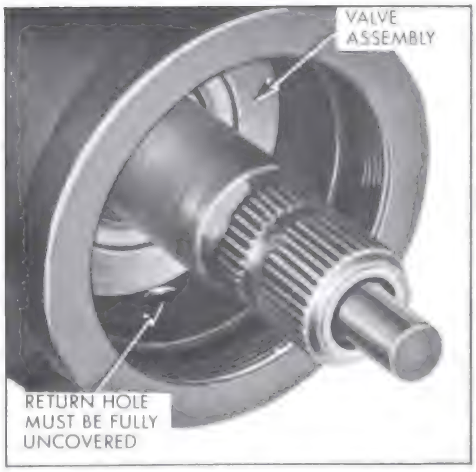


Figure 8-47—Valve Assembly Properly Installed in Housing

4. Tighten adjuster plug lock nut with adjustable Spanner Wrench J-7624. Recheck thrust bearing preload to be sure that tightening lock nut did not change adjustment.

8-15 DISASSEMBLY, INSPECTION AND ASSEMBLY OF PITMAN SHAFT ASSEMBLY

a. Removal of Pitman Shaft Assembly

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Place gear assembly in vise.

3. Rotate the stub shaft until pitman shaft gear is in center position. Remove the housing side cover retaining bolts.

4. Tap the end of the pitman shaft with a soft mallet and slide shaft out of housing.

5. Remove the side cover "O" ring seal and discard.

b. Disassembly of Pitman Shaft Assembly

1. Remove the pitman shaft seal retaining ring from end of housing using No. 3 Truarc Pliers J-4245 and remove outer seal back-up washer. Tap a screwdriver between the outer seal and the inner back-up washer and pry out seal. Tap the screwdriver between the inner seal and the shoulder in the gear housing and pry out inner seal. Be careful not to damage the seal bore in housing. Discard seals.

2. Check the pitman shaft needle bearing for being worn, pitted or scored. If damaged, remove needle bearing from gear housing bore by driving from the seal bore side of housing using Tool J-6657. See Figure 8-48. Discard bearing.

3. Hold the lash adjuster with an Allen Wrench and remove the lash adjuster nut. Discard nut. Remove side cover from lash adjuster.

c. Inspection of Pitman Shaft Assembly

1. Inspect pitman shaft bushing surface in side cover for excessive wear or scoring. If worn or scored, replace side cover.

2. Check the pitman shaft sector teeth and the bearing and seal surfaces. If worn, pitted or scored replace pitman shaft.

3. Check the torque on the lash adjuster. See Figure 8-49. If torque exceeds 15 inch pounds, pitman shaft assembly should be replaced.

d. Reassembly of Pitman Shaft Assembly

1. If pitman shaft needle bearing was removed because of damage, install new needle bearing into gear housing bore from seal bore end, pressing against stamped identification on bearing with Tool J-6657. Press in until bearing clears shoulder in gear housing, 1/32" maximum. Rollers in bearing must be free to rotate.

2. Lubricate new pitman shaft seals in automatic transmission oil. Install the inner, single lip seal in bore first, then a back-up washer. See Figure 8-50. Using Tool J-6219, drive the seal and washer in far enough to provide clearance for the outer seal, back-up washer and retaining ring. See Figure 8-51. The inner seal must not bottom on the counterbore. Install the outer double lip seal and the second back-up washer in bore only far enough to provide clearance for the retaining ring with Tool J-6219. Install retaining ring with No. 3 Truarc Pliers Tool J-4245, making certain that ring is seated properly.

3. Assemble the side cover on the pitman shaft. Screw the lash adjuster through the side cover until the side cover bottoms on the shaft and then back off 1/2 turn.

e. Installation of Pitman Shaft Assembly

1. Lubricate a new side cover "O" ring seal in automatic transmission oil and install in groove in the face of side cover.

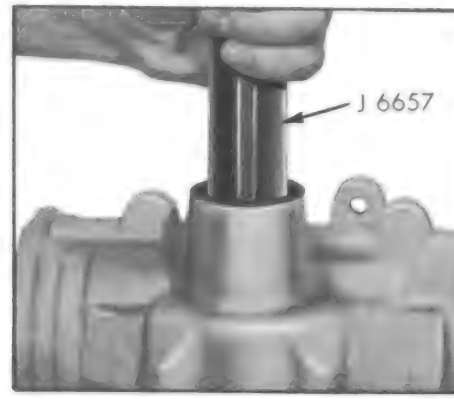


Figure 8-48—Removing Pitman Shaft Needle Bearing

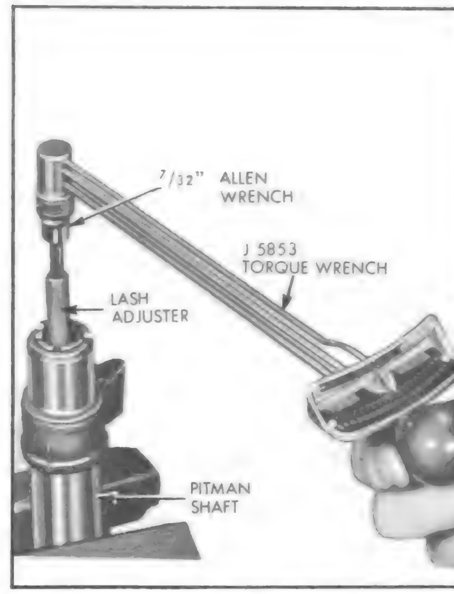


Figure 8-49—Checking Torque on Lash Adjuster

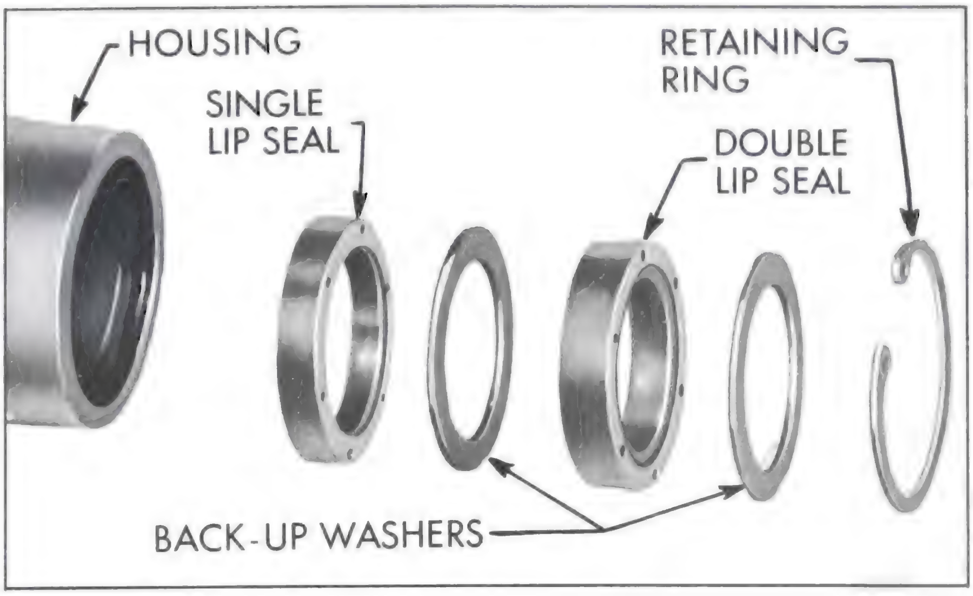


Figure 8-50—Pitman Shaft Seals

Figure 8-51—Installing Pitman Shaft Seals

2. Turn the stub shaft until the center groove of the rack-piston is aligned with the center of the pitman shaft hole.

3. Wrap masking tape over the end of pitman shaft. Install the pitman shaft so that the center tooth in the sector meshes with the center groove of the rack-piston nut. Make sure the side cover "O" ring seal is in place before pushing the side cover down on gear housing. Remove masking tape from end of shaft.

4. Install the four side cover bolts with lock washers and tighten to 30 ft. lbs.

5. Install new lash adjuster nut on lash adjuster, but do not tighten.

6. Adjust pitman shaft as outlined in paragraph 8-13 (b).

8-16 DISASSEMBLY, INSPECTION AND ASSEMBLY OF RACK-PISTON NUT AND WORM ASSEMBLY

a. Removal of Rack-Piston Nut and Worm Assembly

1. Thoroughly clean exterior of gear assembly with a suitable solvent. Drain the unit by placing the valve ports down and turning the worm through its entire range two or three times.

2. Remove pitman shaft assembly as outlined in paragraph 8-15 (a).

3. Rotate housing end plug retainer ring so that one end of ring is over hole in gear housing. Spring one end of ring with punch to allow screwdriver to be inserted to lift ring out. See Figure 8-52.

4. Rotate stub shaft to full left turn position to force end plug out of housing.

CAUTION: Do not rotate farther than necessary or the balls from the rack-piston and worm assembly will fall out.

5. Remove and discard housing end plug "O" ring seal.

6. Remove rack-piston nut end plug with a 1/2 square drive. See Figure 8-53.

7. Insert Ball Retaining Tool J-7539 in end of worm. See Figure 8-54. Turn stub shaft so that rack-piston nut will go onto the tool and remove rack-piston nut from gear housing. Keep ball retaining tool completely through rack-piston nut to prevent balls from falling out.

NOTE: Do not remove snap ring in upper end of piston bore in housing.

Figure 8-52—Removing Housing End Plug Retaining Ring

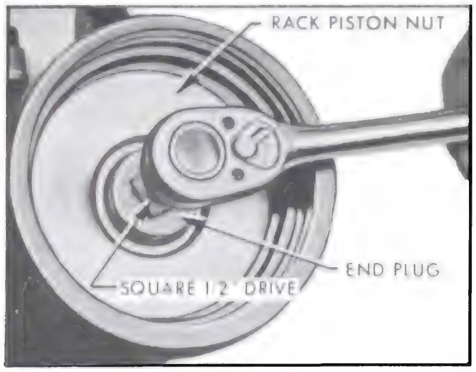


Figure 8-53—Removing Rack-Piston Nut End Plug

8. Remove adjuster plug assembly and rotary valve assembly as outlined in paragraph 8-14 (a).

9. Remove worm and lower thrust bearing and races.

10. Remove cap to worm "O" ring seal and discard.

b. Disassembly of Rack-Piston Nut and Worm Assembly

1. Remove and discard piston ring and back-up "O" ring on rack-piston nut.

2. Remove ball return guide clamp to rack-piston nut screws and lock washers and remove clamp.

3. Place the rack-piston nut on a clean cloth and remove ball return guide and ball retaining tool. Make sure all 22 balls are caught on the cloth.

c. Inspection of Rack-Piston Nut and Worm Assembly

1. Inspect gear housing bore. If badly scored or worn, replace housing.

2. Inspect the worm and rack-piston nut grooves and all the balls for excessive wear or scoring. Inspect rack-piston nut teeth for pitting, wear or scoring. Inspect O.D. of rack-piston nut for wear, scoring or burrs. If either the worm or rack-piston nut need replacing, both must be replaced as a matched assembly.

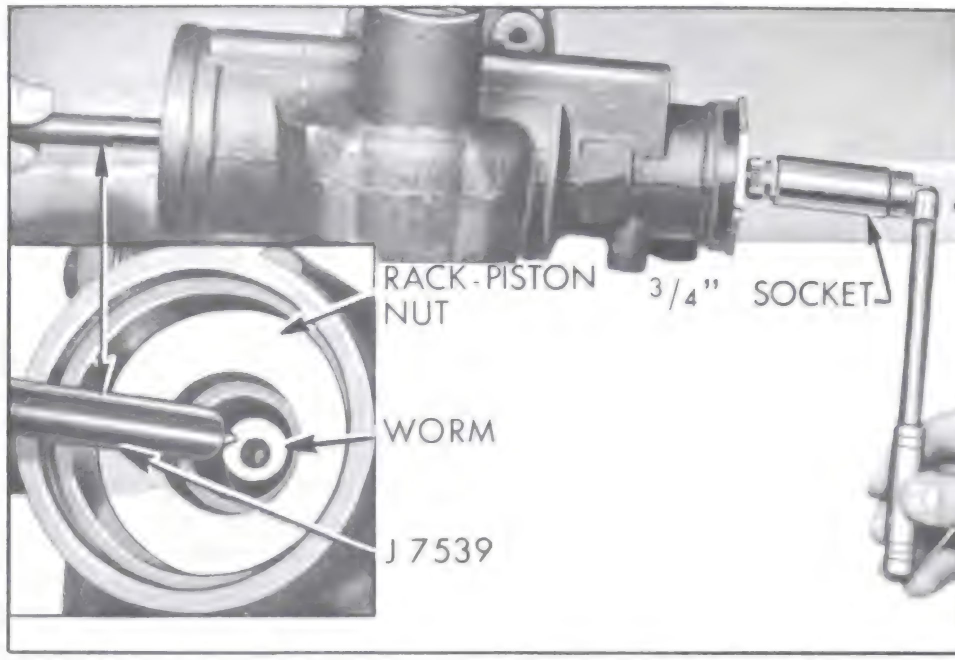


Figure 8-54—Removing Rack-Piston Nut

3. Inspect ball return guides, making sure that the ends where the balls enter and leave the guides are not damaged. Replace if necessary.

4. Inspect lower thrust bearing and races for wear, pitting, scoring or cracking. Replace any damaged parts.

5. Inspect the hose connectors on gear housing. If badly brinelled or scored, replacement will be necessary. To remove the connectors, tap threads using 5/16-18 tap. Thread a bolt with a nut and flat washer into the tapped hole. Pull the connector by holding the bolt and turning the nut off the bolt. Wash and blow the housing out thoroughly to remove any tapping chips. To install new connector, use Replacer J-6217 to drive connector in place.

6. Check the operation of check valve poppet located under connector in pressure port of housing. Poppet should reseat itself against connector after being lightly pushed down. If poppet is not operating properly, remove connector, poppet and spring from pressure port. Then install a new spring with large end down, a new poppet with tangs pointed down. Install a new connector using Installer J-6217. Be sure new poppet operates properly.

7. Inspect the ball plug in gear housing. If it is leaking or raised above the housing surface, it may be driven in flush to 1/16 inch below surface. The ball can be tightened by staking the housing. If the leakage cannot be stopped, the housing should be replaced.

d. Reassembly of Rack-Piston Nut and Worm Assembly

1. Thoroughly clean and lubricate the internal parts with automatic transmission oil.

2. Install new piston ring back-up "O" ring in groove on rack-piston nut. Place a new piston ring over the back-up "O" ring. See Figure 8-55.

3. Install worm into rack-piston nut to bearing shoulder.

4. Align the ball return guide holes in the rack-piston nut with the worm groove. Load 16 balls, 8 plain and 8 black in alternate sequence into the guide hole nearest the piston ring while slowly

Figure 8-55—Installing Piston Ring on Rack-Piston Nut

rotating worm counterclockwise. See Figure 8-56.

5. Fill one-half the ball return guide with the remaining 6 balls, 3 plain and 3 black balls in alternate sequence. Place the other half of guide over the balls and plug each end with heavy grease to prevent the balls from falling out when installing the guide to the rack-piston nut.

6. Insert ball return guide into guide holes of the rack-piston nut so that balls in the guide alternate with the balls in the rack-piston nut. Guide should fit loosely.

7. Place clamp over guide and install 2 screws with special lock washers and tighten.

8. The worm groove is ground with a high point in the center. When the rack-piston nut passes over this high point, a preload of 1 to 5 inch pounds should be obtained. To measure the preload of the assembly, lightly clamp rack-piston nut in a soft jaw vise with worm pointing up. Do not distort rack-piston nut by tightening too heavily. Place valve assembly on worm, engaging worm drive pin. Rotate the worm until it extends 1-1/4 inches from the edge of rack-piston nut to the thrust bearing face of worm; this is the center position.

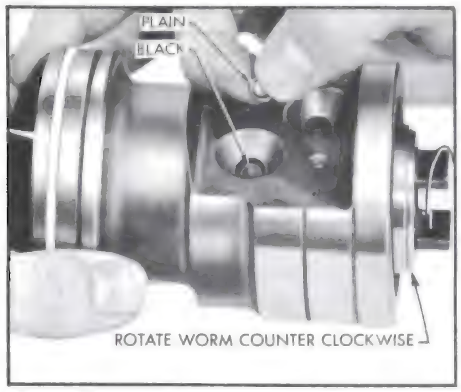


Figure 8-56—Loading Balls in Rack-Piston Nut

Attach Torque Wrench J-5853 with 3/4 inch, 12 point socket to the stub shaft. See Figure 8-57. Rotate the wrench through a total arc of approximately 60 degrees (1/6 turn) in both directions several times and take a reading. The highest reading obtained with the worm rotating should be from 1 to 5 inch pounds. If the reading is too high, disassemble and reassemble, using the next size smaller plain balls and recheck. (A rack-piston nut with a ball size of 7 does not have a number stamped on the flat surface. For ball sizes other than 7, the ball size is stamped on the flat surface of the rack-piston nut.) If the reading is too small, use the next size larger plain balls and recheck. See paragraph 8-8, subparagraph b for ball size. Remove valve assembly from worm.

Figure 8-57—Checking Rack-Piston Nut Ball Preload

9. Turn the rack-piston nut and worm assembly to a horizontal position in the vise and insert ball retaining Tool J-7539 in end of worm and turn worm out of the rack-piston nut. Do not allow the tool to separate from the worm until worm is fully removed from rack-piston nut.

e. Installation of Rack-Piston Nut and Worm Assembly

1. Assemble lower thrust bearing and races on worm. Install new cap to worm "O" ring seal. Assembly rotary valve assembly to worm by aligning narrow pin slot in valve body with pin on worm.

2. Insert the valve assembly and worm in gear housing as an integral unit. Do not press on stub shaft or torsion bar. See Figure 8-46. Return hole in housing should be fully visible when valve and worm are properly installed. See Figure 8-47.

3. Place Seal Protector J-6222 over end of stub shaft. Install adjuster plug assembly in gear housing snugly with adjustable Spanner Wrench J-7624 then back plug off approximately 1/8 turn. Install adjuster plug lock nut if removed, but do not tighten.

4. Adjust the thrust bearing preload. Using Torque Wrench J-5853, rotate stub shaft to measure valve assembly drag. See Figure 8-32. Then tighten adjuster plug to obtain a reading 1 to 3 inch lbs. in excess of valve drag.

Total of thrust bearing preload and valve drag should not exceed 11 inch lbs.

5. Tighten adjuster plug locknut. Recheck thrust bearing preload to be sure that tightening lock nut did not change adjustment.

6. Install ring compressor sleeve Tool J-7576 in gear housing and hold it tightly against shoulder in the housing. See Figure 8-58. Insert the rack-piston nut into the housing until the ball retaining Tool J-7539 engages the worm. Turn the stub shaft drawing the rack-piston nut into the housing. When the piston ring is into the housing bore, the ball retaining tool and the ring compressor may be removed.

7. Install rack-piston end plug using 1/2 square drive. Torque plug to 50 ft. lbs. See Figure 8-59.

8. Lubricate housing end plug "O" ring seal with automatic transmission oil and install in gear housing.

9. Insert end plug into gear housing and seat against "O" ring seal. Slight tapping with a soft mallet may be necessary to seat plug properly. Install end plug retainer ring.

10. Install pitman shaft assembly as outlined in paragraph 8-15, subparagraph e, Steps 1 through 5.

11. Turn lash adjuster counterclockwise a few turns and obtain a reading with Torque Wrench J-5853 while rotating stub shaft

Figure 8-58—Installing Rack-Piston Nut

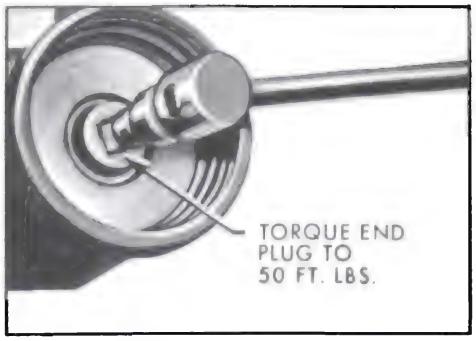


Figure 8-59—Torquing Rack-Piston Nut End Plug

through "high point" range. Adjust lash adjuster to obtain a reading 4 to 8 in. lbs. higher than first reading.

8-17 DISASSEMBLY, INSPECTION AND ASSEMBLY OF OIL PUMP

Refer to paragraph 8-12 for removal and installation of oil pump.

a. Disassembly of Saginaw Oil Pump

1. Use shipping caps to cover the hose union and pipe on pump and thoroughly clean exterior of pump.

2. Remove pump pulley key from pump shaft.

3. Remove reservoir cap and drain out oil in pump reservoir.

4. Install pump in a soft jaw vise with pump shaft pointing down. Do not clamp pump too tightly in vise as this may distort bushing.

5. Remove two reservoir to pump housing studs with "O" rings. Discard the "O" rings.

6. Remove pressure union. Remove "O" ring from union and discard.

7. Remove reservoir from housing by rocking back and forth while pulling upward. Remove reservoir "O" ring seal on housing and discard. Remove small reservoir to housing "O" ring seal from counterbore in housing and discard.

8. Rotate end plate retaining ring until one end of ring is over hole in housing. Spring one end of ring with 1/8" punch to allow screwdriver to be inserted and lift ring out. See Figure 8-60.

9. Remove pump from vise and remove end plate, two pressure plate springs, flow control valve and spring by turning pump over. If end plate should stick in housing, lightly tap it to align and free it.

NOTE: Do not disassemble flow control valve.

10. Remove and discard end plate "O" ring seal.

11. Place shaft end on bench and press down on housing until shaft is free. Turn housing over and remove shaft and rotor assembly, being careful not to drop parts. If the two dowel pins did not come out with assembly, remove dowel pins from housing.

12. Remove and discard pressure plate "O" ring seal.

13. Remove shaft seal, if defective, by prying out with small screwdriver.

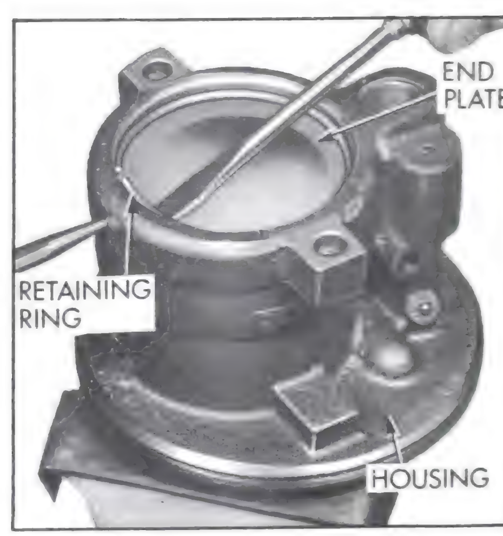


Figure 8-60—Removing End Plate Retaining Ring

b. Inspection of Oil Pump Parts

Clean all parts thoroughly with solvent and wipe dry with clean, lint-free cloth before inspecting.

1. Inspect shaft for wear.

2. Check fit of the ten vanes in slots of rotor; vanes must slide freely but fit snugly in slots. Tightness may be removed by thorough cleaning or removal of irregularities using a hard Arkansas stone. Replace rotor if excessive looseness exists between rotor and vanes and replace vanes if they are irregularly worn or scored. Light scoring on the rotor can be repaired by carefully lapping surface of rotor.

3. Inspect all ground surfaces of the rotor ring for roughness or irregular wear. Slight irregularities may be removed with a hard Arkansas stone. Replace ring if inside cam surface is badly scored or worn and inspect outside radius of vanes very closely for damage.

4. Inspect the surfaces of the pressure plate and thrust plate for wear or scoring. Light scoring can be repaired by carefully lapping until surface is smooth and flat, after which all lapping compound must be thoroughly washed away.

5. Inspect the flow control valve bore in the housing for scoring, burrs or other damage. Hair line scratches are normal. Inspect bushing in housing, if worn or scored, replace housing.

6. Inspect the surfaces of the flow control valve for scores and burrs. Hair line scratches are normal. Replace valve if badly scored or if it is the cause of low pump pressure. Check the screw in the end of the valve, if loose, tighten being careful not to damage machined surfaces. Filter in end of screw must be clean.

7. Check orifice in pressure union to be sure it is not plugged.

c. Assembly of Oil Pump

1. Make sure all parts are absolutely clean. Lubricate seals and moving parts with automatic transmission oil during assembly.

2. If shaft seal was removed, use Installer J-7017 to drive new seal into housing with spring side of seal toward housing. See Figure 8-62. Just bottom seal in housing.

3. Mount housing in vise with shaft end down. Install new pressure plate "O" ring seal in groove in housing bore. This seal is smaller than the end plate "O" ring seal and it has a daub of paint on it for identification.

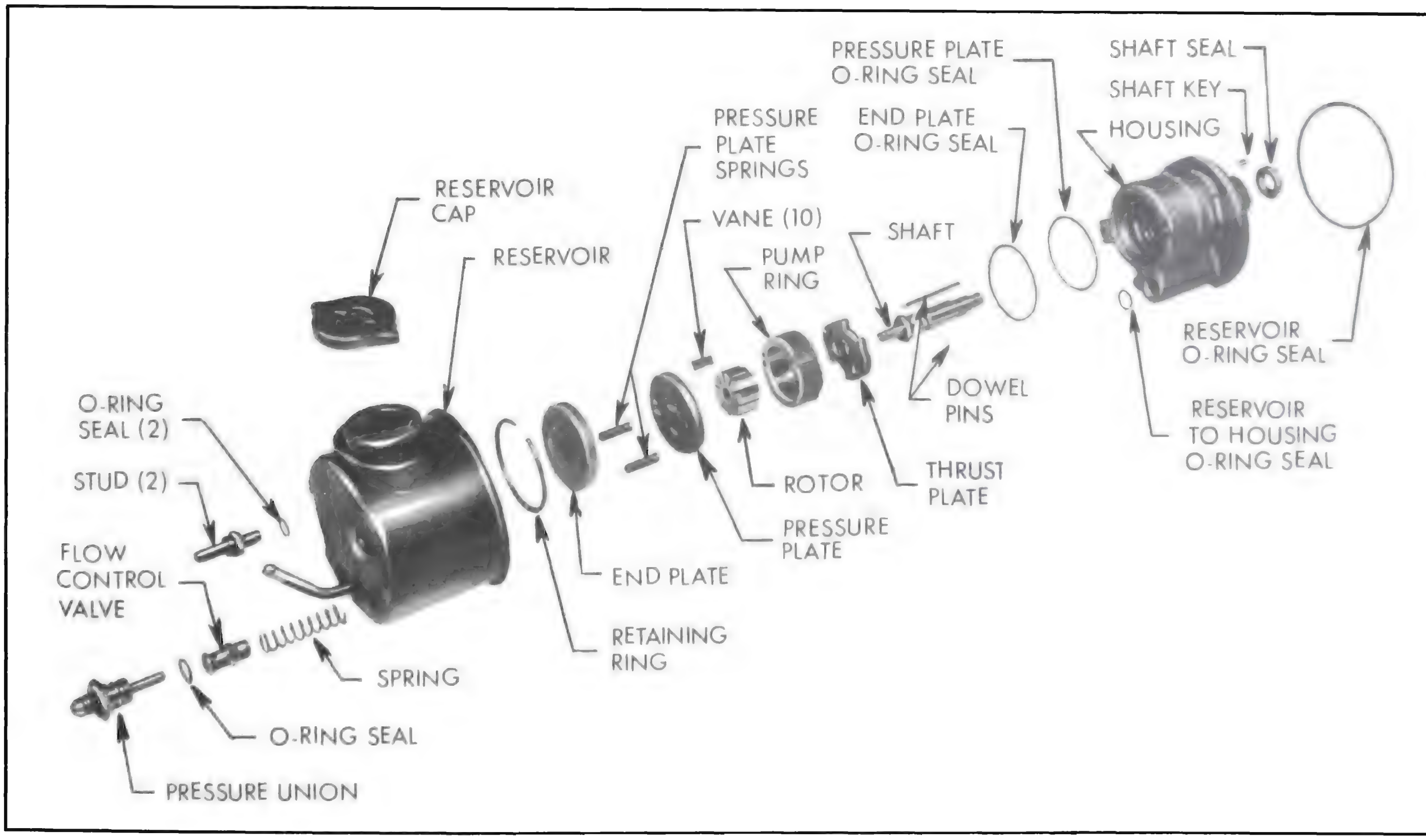


Figure 8-61—Exploded View of Oil Pump

Figure 8-62—Installing Shaft Seal

4. Insert shaft into housing and press down with thumb on splined end to properly seat shaft. Be careful not to damage shaft seal in housing.

5. Install the two dowel pins in housing and install thrust plate on the pins with ported face of plate to rear of housing.

6. Install pump ring with small holes in ring on dowel pins and with arrow on outer edge to rear of housing.

7. Install rotor on pump shaft with alignment sleeve toward front of housing. Rotor must be free on shaft splines.

8. Install ten vanes in rotor slots with radius edge toward outside and flat edge toward center of rotor.

9. Lubricate the outside diameter and chamfer of pressure plate with petroleum jelly and install on dowel pins with ported face toward pump ring. Dowel pins fit into slots in plate that are nearest outside diameter of plate. Use a soft plastic or wood rod and lightly tap around outside diameter of pressure plate to seat it. See Figure 8-63. Pressure plate will travel about 1/16" to seat. Never press or hammer on the

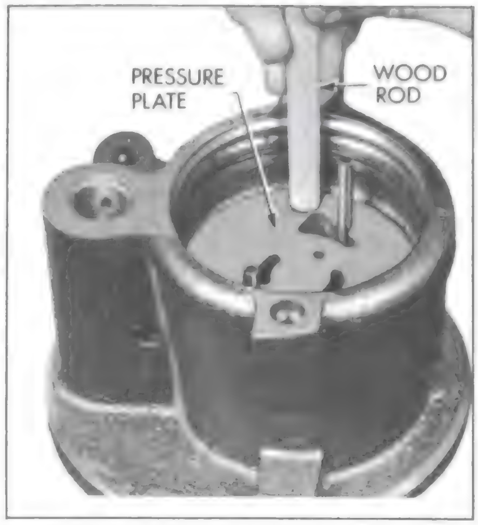


Figure 8-63—Seating Pressure Plate in Housing

center of pressure plate as this will cause permanent distortion and result in pump failure.

10. Install new end plate "O" ring seal in groove in bore of housing. Be sure not to install it in end plate retaining ring groove which is first groove from rear of housing.

11. Install the two pressure plate springs on the dowel pins.

12. Lubricate outside diameter and chamfer of end plate with petroleum jelly and insert in housing.

13. Place end plate retaining ring on top of end plate. Lay a 1/4" spacer on center of end plate, then position Installer J-7663 on end plate so that the depression on it is against the spacer. See Figure 8-64. Attach installer to housing using the reservoir to housing studs with long end of studs threading in housing. Press end plate down by tightening studs until ring groove in housing is evenly exposed. Install retaining ring. Be sure ring is completely seated in housing groove and end plate is aligned properly. Remove studs.

CAUTION: Press end plate into housing only far enough to install retaining ring in groove.

14. Install new reservoir "O" ring seal on housing. Place a new small reservoir to housing "O" ring seal in counterbore in housing.

15. Install reservoir on housing and line up holes for studs. Tap reservoir with a soft mallet to seat it on housing and install reservoir to housing studs with new "O" ring seals. Tighten studs to 30 ft. lbs.

16. Install flow control spring in housing. Then install flow control valve with screw head of valve going in housing first.

17. Assemble new "O" ring in groove nearest outlet end of pressure union. Install union in pump and tighten to 30 ft. lbs.

CAUTION: If "O" ring is installed in groove on pressure union that contains the flow orifice, pump will not build-up pressure.

18. Remove pump from vise and install shaft key on shaft. Support shaft on opposite side while installing key.

19. Check for bind in pump by rotating drive shaft. Shaft must rotate freely by hand.

8-18 REMOVAL AND INSTALLATION OF OIL PUMP SHAFT SEAL WITH PUMP NOT REMOVED

a. Removal

NOTE: On air conditioner cars it is necessary to remove pump from engine as the fan shroud is in the way.

1. Remove fan guard.

2. Remove pump pulley nut.

3. Remove pump drive belt from pulley.

4. Remove pulley from pump using a suitable puller. Do not hammer pulley off shaft.

5. Remove pulley drive key from shaft.

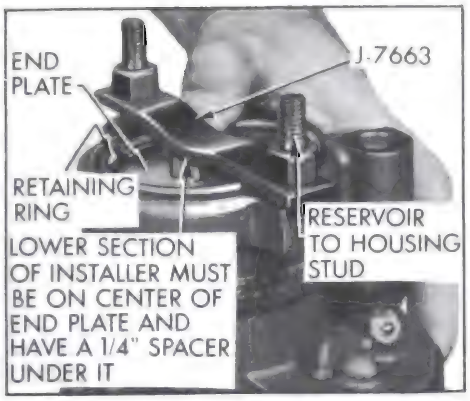


Figure 8-64—Installing Housing End Plate

6. Insert a piece of .005" shim stock (approximately 2-1/2" long) around shaft and push it past seal until it bottoms in pump housing. See Figure 8-65.

7. Remove seal by cutting metal body of seal with a sharp tool and prying out. See Figure 8-65. Extreme care must be used to prevent damage to shaft and pump housing.

b. Installation

1. Place seal Protector J-7586 over shaft. Lubricate new seal with automatic transmission oil and drive in pump housing spring side first with Installer J-7728. See Figure 8-66. Just bottom seal in housing. Excessive force must not be used when driving seal in place.

2. Install pulley drive key on shaft.

3. Install pulley and drive belt. Adjust belt tension. See Figure 2-39.

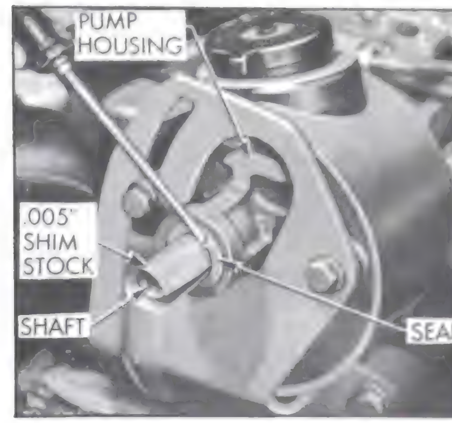


Figure 8-65—Removing Oil Pump Shaft Seal

4. Fill pump reservoir to proper level with automatic transmission oil and bleed pump as instructed in paragraph 8-12, subparagraph e.

5. Install fan guard.

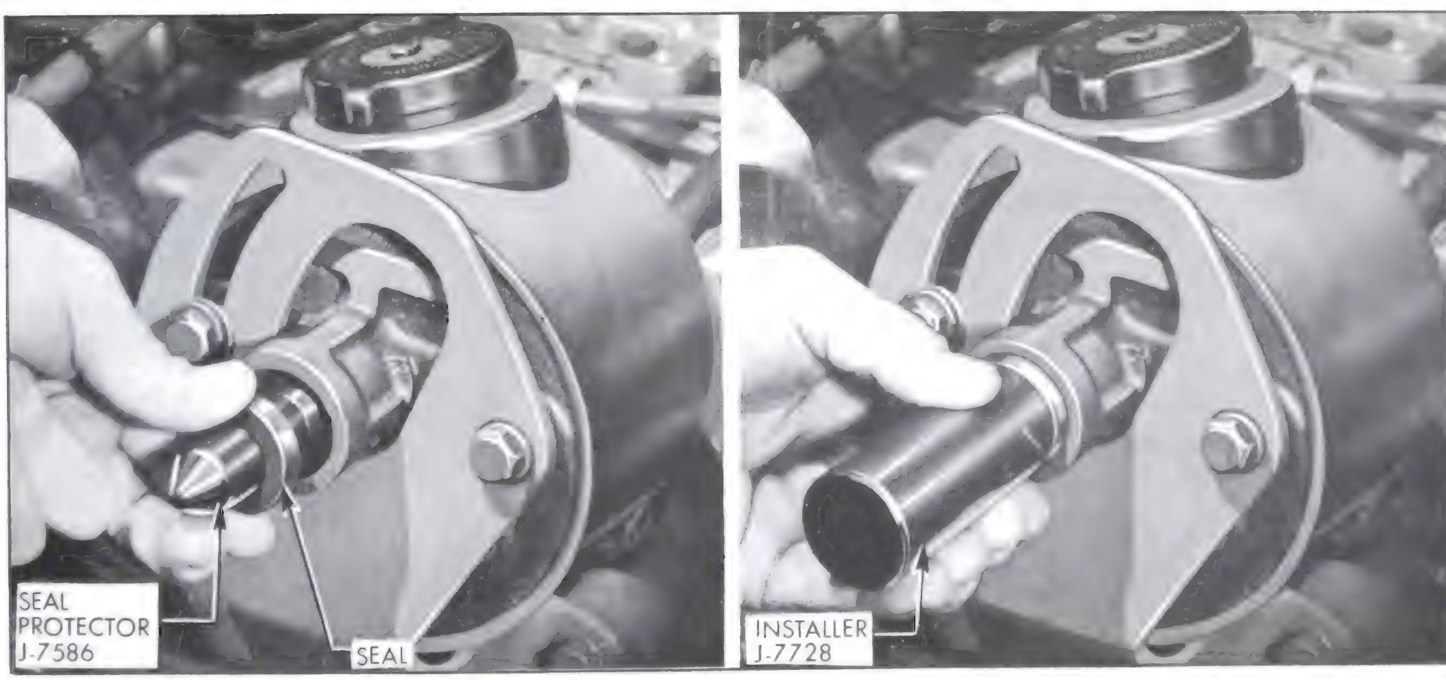


Figure 8-66—Installing Oil Pump Shaft Seal

SECTION 8-C

MANUAL AND POWER STEERING LINKAGE

CONTENTS OF SECTION 8-C

8-19 STEERING LINKAGE SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque Ft. Lbs.
Bolt & Nut	Tie Rod Clamp	3/8-24	20-27
Bolt	Idler Arm Support to Frame	3/8-24	40-50
Nut	Tie Rod Ball Stud to Steering Arm & Intermediate Rod	1/2-20	50-60
Nut	Pitman & Idler Arm to Intermediate Rod	1/2-20	50-60
Nut	Pitman Arm to Pitman Shaft	7/8-14	90-110
Bushing	Idler Arm (Saginaw)	7/8-11	100-115

b. Steering Linkage Specifications

	Specification
Type	Parallelogram
Make	
Manual Steering	Saginaw Steering
Power Steering	Saginaw Steering & Thompson Products
Turning Circle Diameter (Curb to Curb)	
Series 4400-4600	45.9 ft.
Series 4700	43.6 ft.
Series 4800	47.6 ft.
Toe-in, Caster, Camber, etc.	See Group 7

8-20 DESCRIPTION OF STEERING LINKAGE

The parallelogram type steering linkage is used to connect both front wheels to the steering gear pitman arm. The right and left tie rods are attached to a forged intermediate rod by ball studs. The left end of the intermediate rod is supported by the pitman arm and the right end by an idler arm which pivots on a support attached to the frame. The pitman and idler arms are always paralleled with each other and move through symmetrical arcs. There are three different linkage set-ups. Two manufactured by Saginaw Steering, one for power gears and the other for manual gears. The third is manufactured by Thompson Products and is used only for power gears. See Figures 8-67 and 8-68.

The inner and outer tie rod ends, the idler arm support bushing and the pitman and idler arm ball studs are of the permanent lubricated design and do not require periodic lubrication, on all linkage assemblies. However, all the ball studs except the pitman arm and idler arm ball studs have removable plugs. If a squeak develops in a stud on a high mileage car, the plug may be removed and a grease fitting (1/4 - 28) installed and stud lubricated as instructed in paragraph 1-3.

When assembling the idler arm to support it must be adjusted as shown on Figure 8-67. There is no adjustment of the Thompson idler arm and support as these parts are serviced as an assembly.

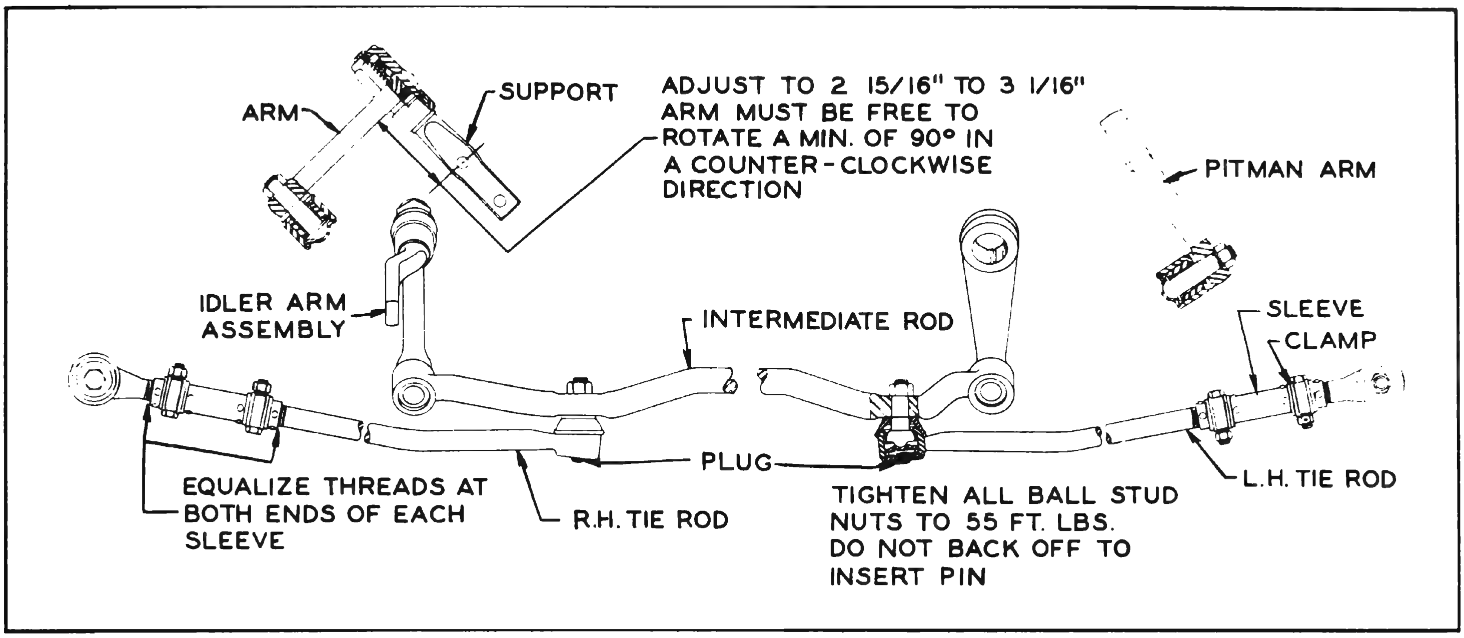


Figure 8-67—Manual and Power Steering Linkage—Saginaw

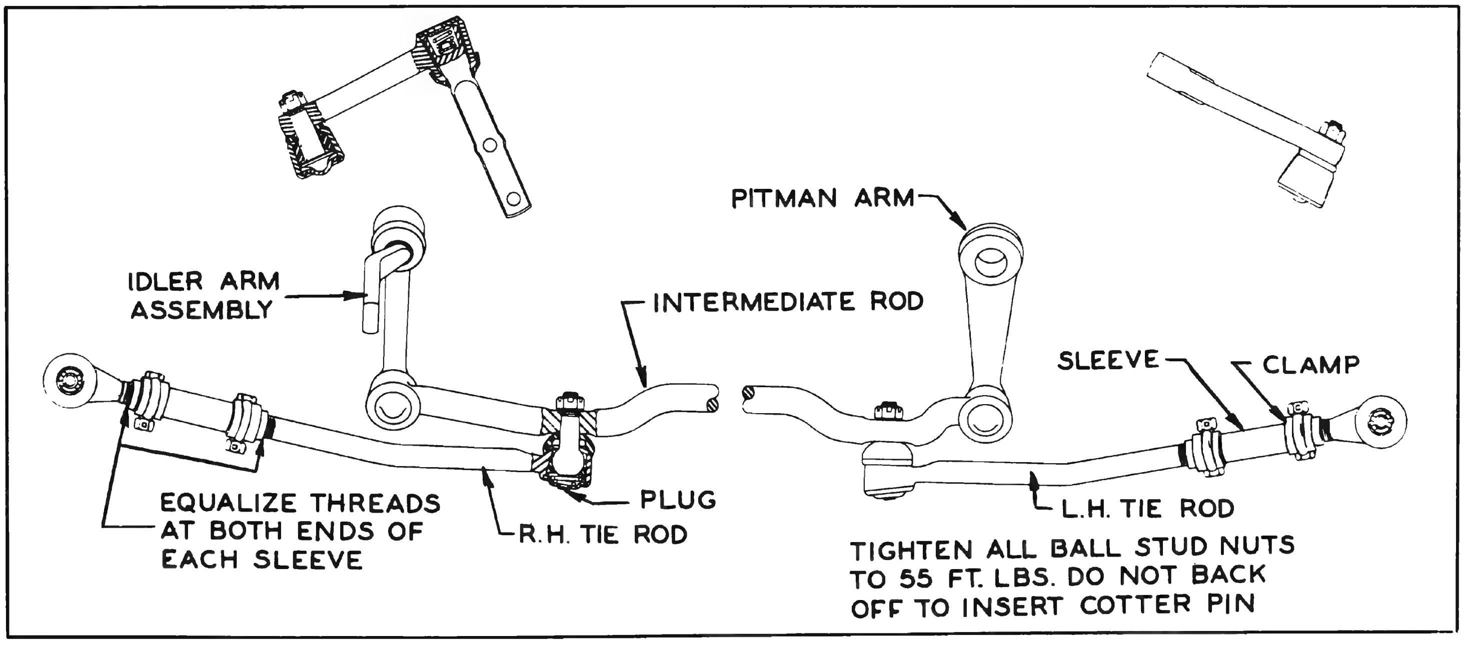


Figure 8-68—Power Steering Linkage—Thompson

The Saginaw manual linkage is the same as the Saginaw power steering linkage, except the manual linkage has a different pitman arm to fit the manual gear pitman shaft.

8-21 ADJUSTMENT OF STEERING LINKAGE IDLER ARM

The Thompson steering linkage does not require any special adjustment as the idler arm and support assembly is self-adjusting.

The Saginaw linkage requires proper location of the idler arm on its support so that the idler arm ball socket will be level with the pitman arm ball socket. The support must be threaded into the idler arm bushing until the distance from the center of the support lower bolt hole to the nearest face of the idler arm is 2-15/16" to 3-1/16", as shown in Figure 8-67 and 8-69. When the idler arm is installed on support, it must be free to rotate a minimum of 90 degrees in a counterclockwise direction.

IMPORTANT: If the Saginaw idler arm support is dismounted

from the frame for other work, wire the support to the idler arm so that it cannot turn from its existing position and possibly change the toe-in of the front wheels.

See Group 7 for adjustment of tie rods to obtain proper toe-in of front wheels.

When disconnecting any of the steering linkage ball studs, use Puller J-5504 where possible. If puller will not work, use Remover J-3295 and firmly support the member that stud is being removed from.

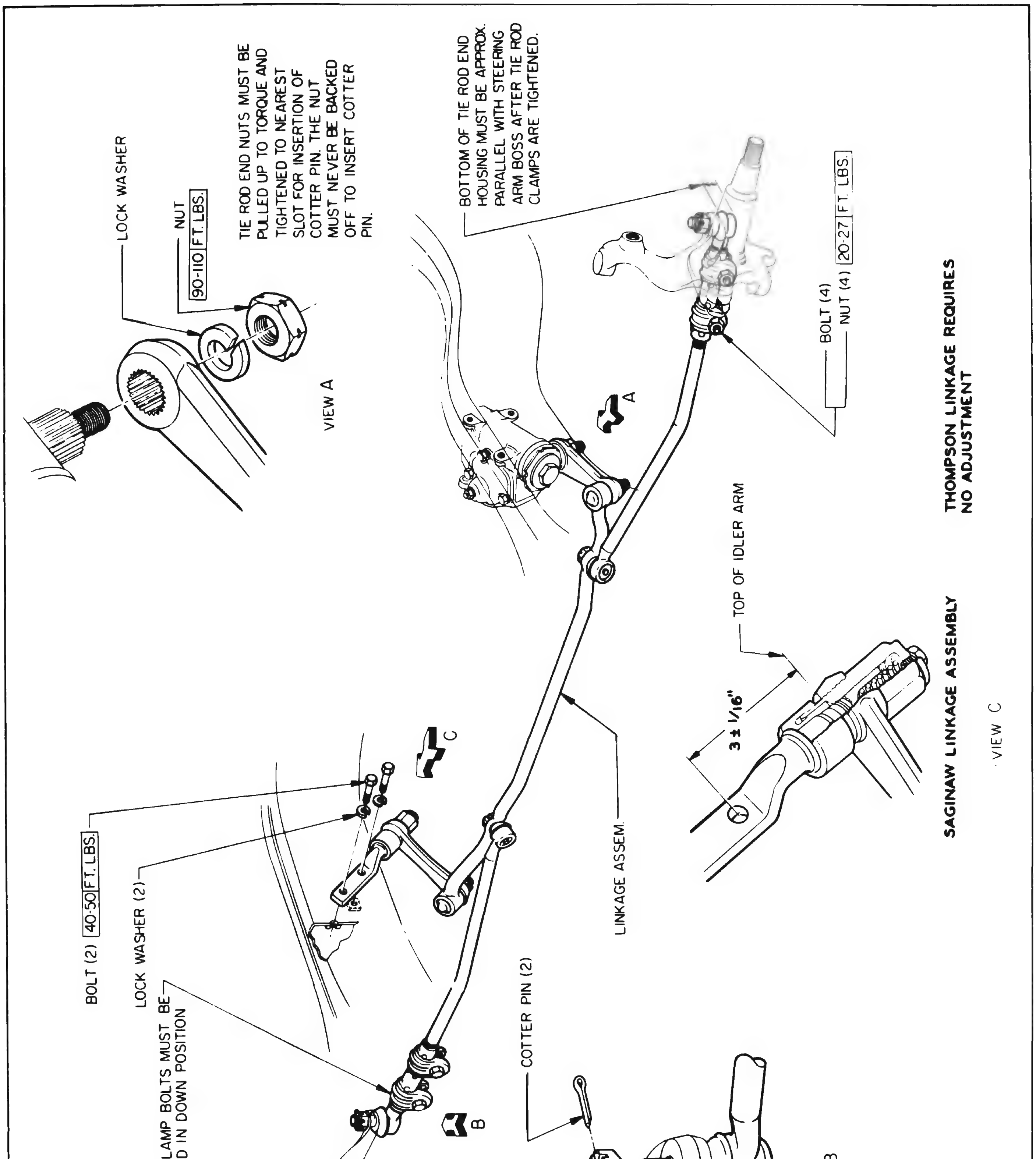
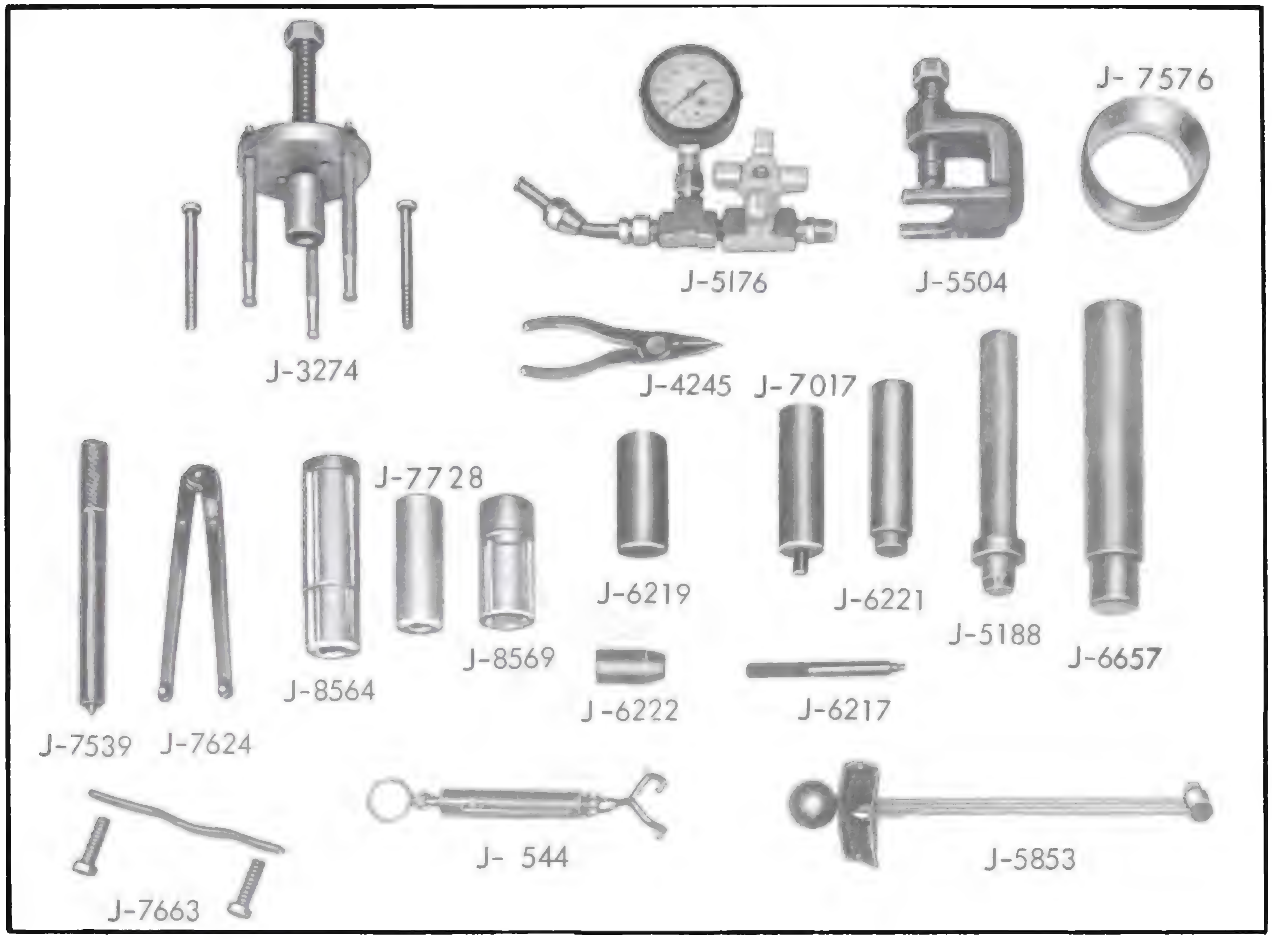


Figure 8-69—Steering Linkage Installation



STEERING TOOLS

J- 544	Steering Gear Tension Scale 0-4 lbs.
J-3274	Steering Wheel Puller
J-4245	Truare Pliers
J-5176	Testing Gauge, Oil Pressure
J-5188	Valve Cover Seal Installer
J-5504	Pitman Arm Puller
J-5853	0-100 in. lb. Torque Wrench
J-6217	Valve Connector Seal Installer
J-6219	Steering Gear Pitman Shaft Oil Seal Installer
J-6221	End Cover Bearing Remover and Installer (Adjuster Plug Needle Bearing)
J-6222	End Cover Seal Protector (Stub Shaft Protector)
J 6657	Pitman Shaft Needle Bearing Remover and Installer
J-7539	Power Steering Gear Ball Retaining Tool
J-7624	Power Steering Gear Adjustable Spanner Wrench
J-7663	Power Steering Pump End Plate Installer
J-8564	Worm Shaft Oil Seal Installer, Manual Gear
J-8569	Pitman Shaft Oil Seal Installer, Manual Gear
J-7017	Power Steering Oil Pump Shaft Seal Installer
J-7728	Power Steering Pump Seal Installer With Shaft in Place
J-7576	Teflon Ring Compressor

Figure 8-70—Steering Gear and Linkage Special Tools

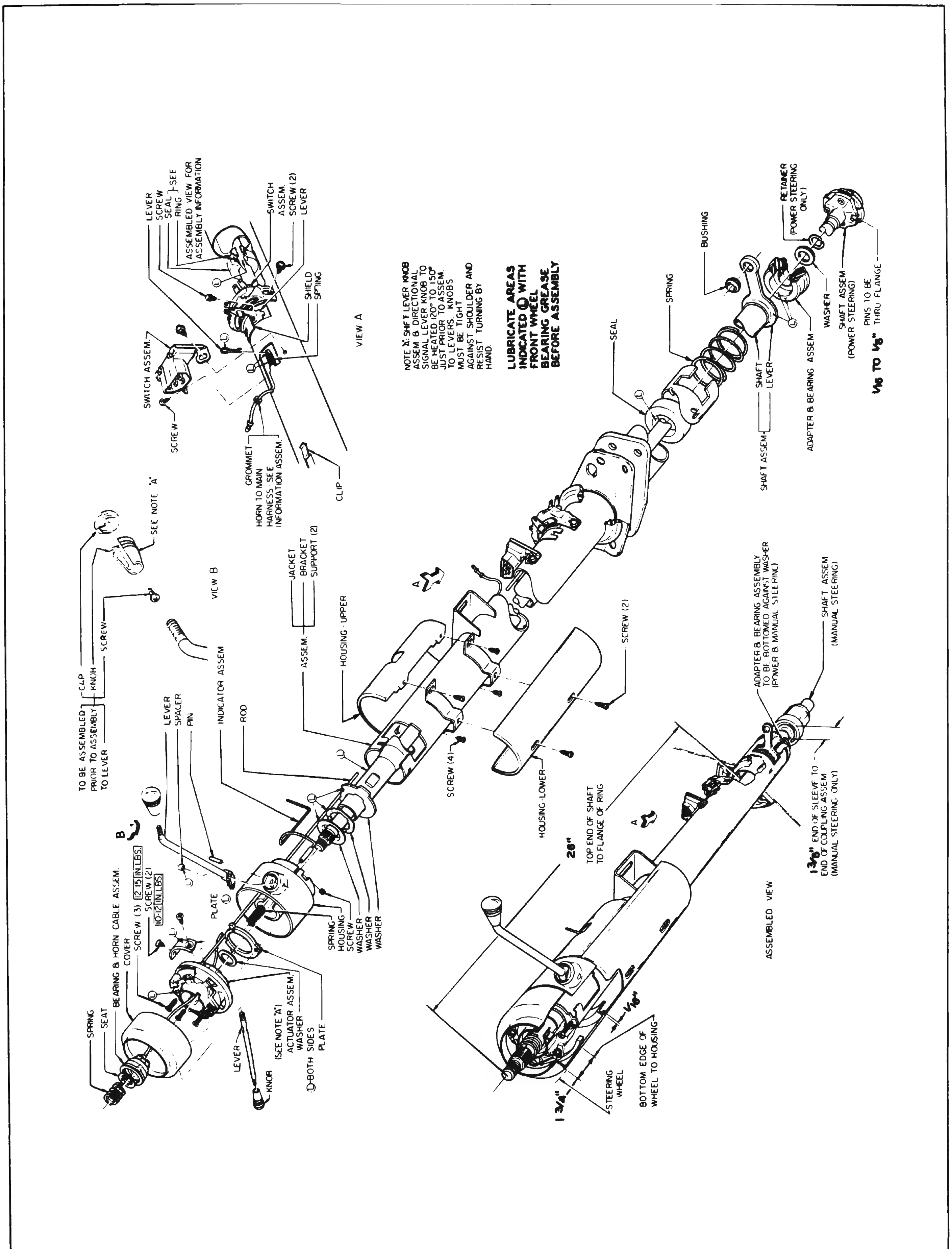


Figure 8-71—Steering Column Jacket and Transmission Control Shaft Assembly—4400-4635-4800 with Automatic Transmission

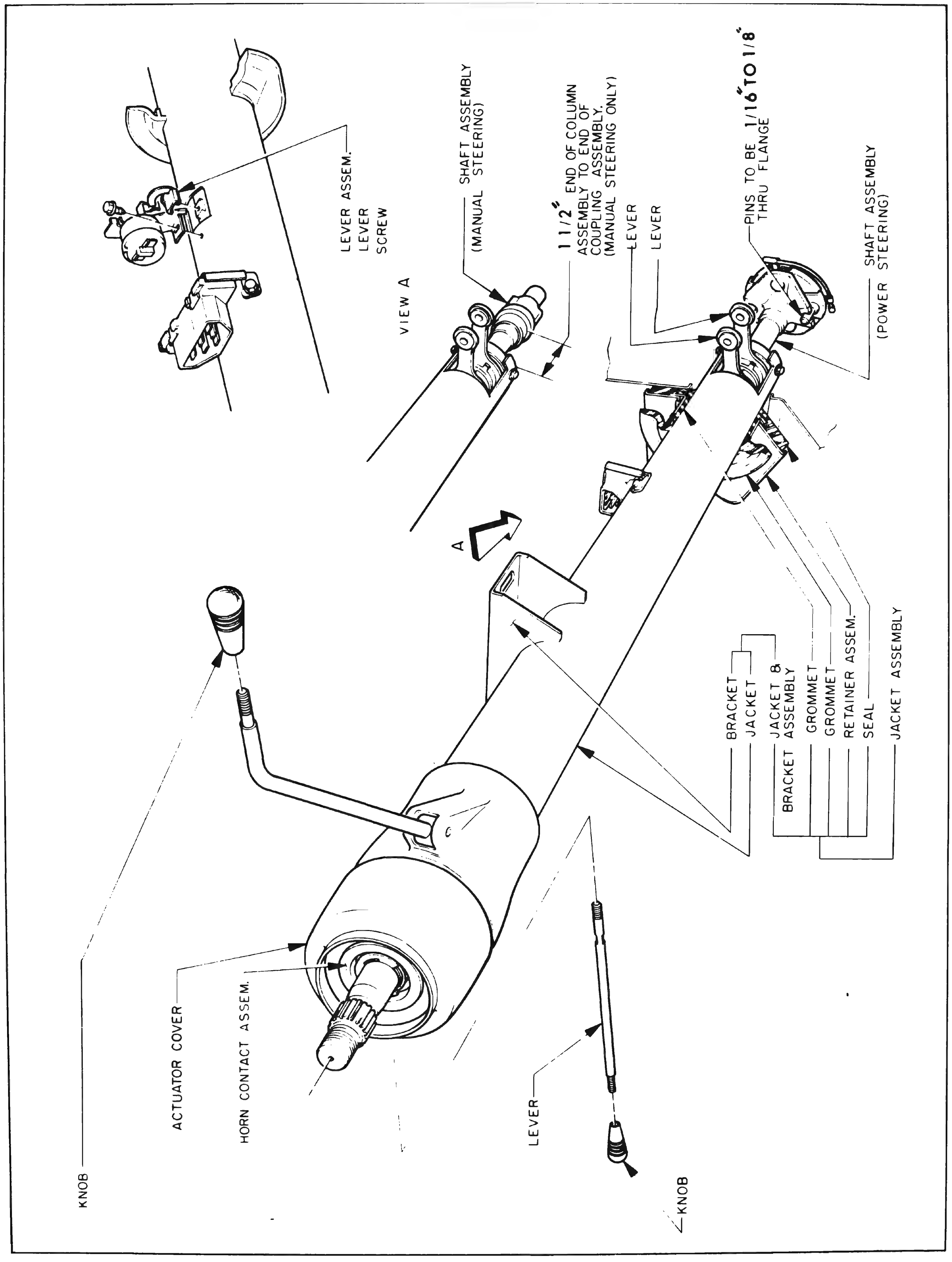


Figure 8-72—Steering Column and Transmission Control Shaft Assembly—4400 Three Speed Synchromesh Transmission

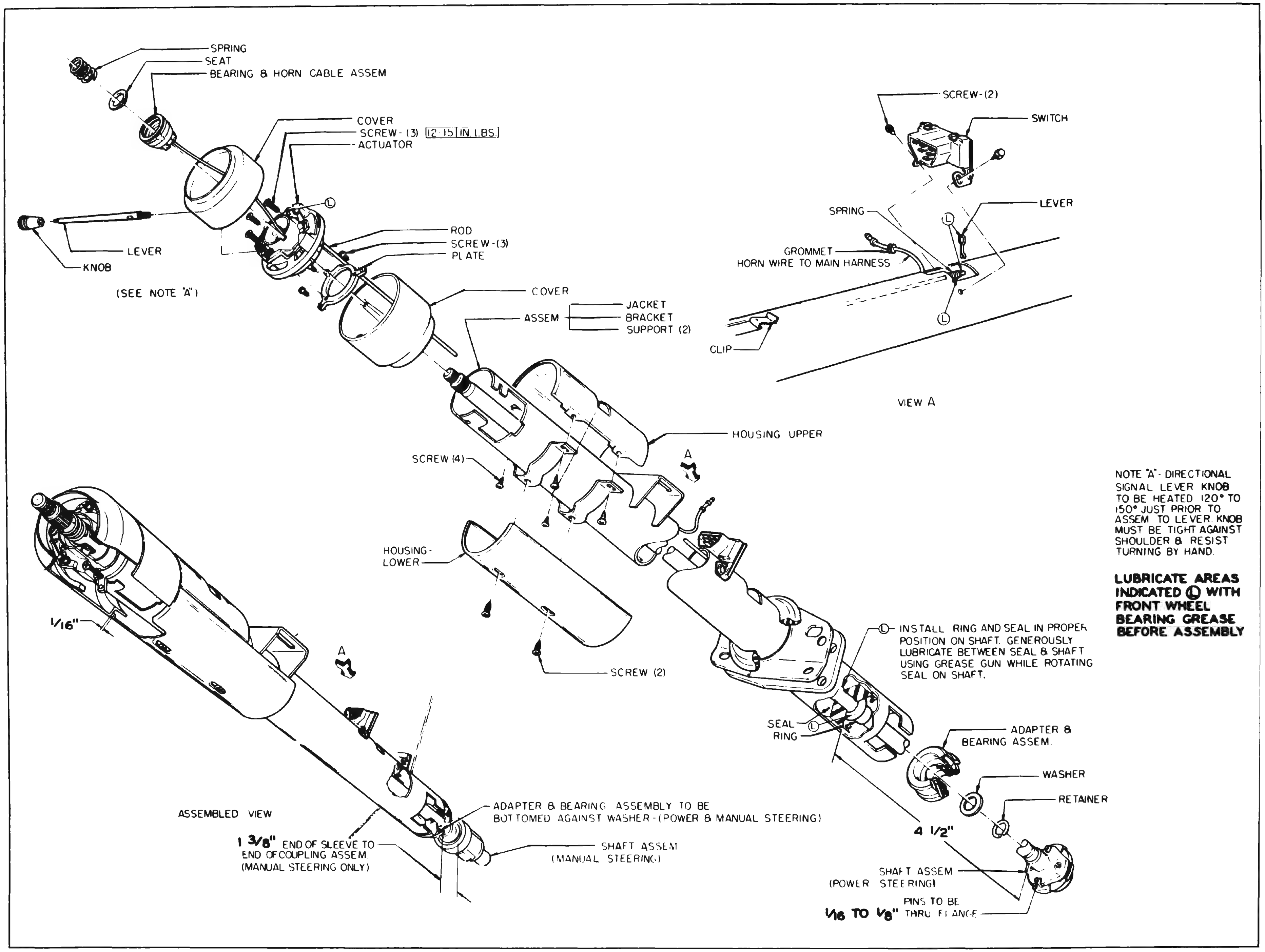


Figure 8-73—Steering Column Assembly—4400—Four Speed Transmission and 4639, 4647, 4667 Series

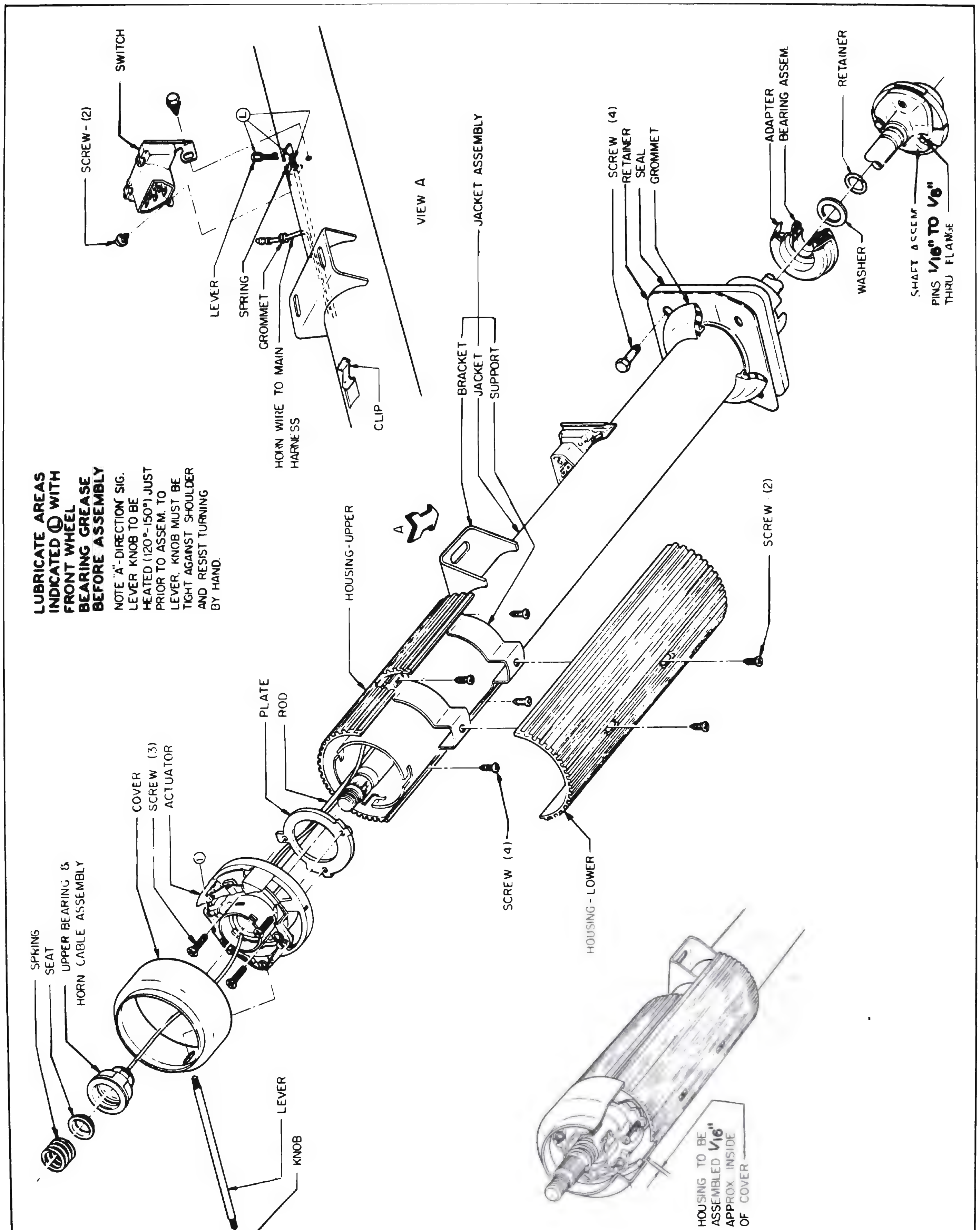


Figure 8-74—Steering Column Assembly—4700 Series

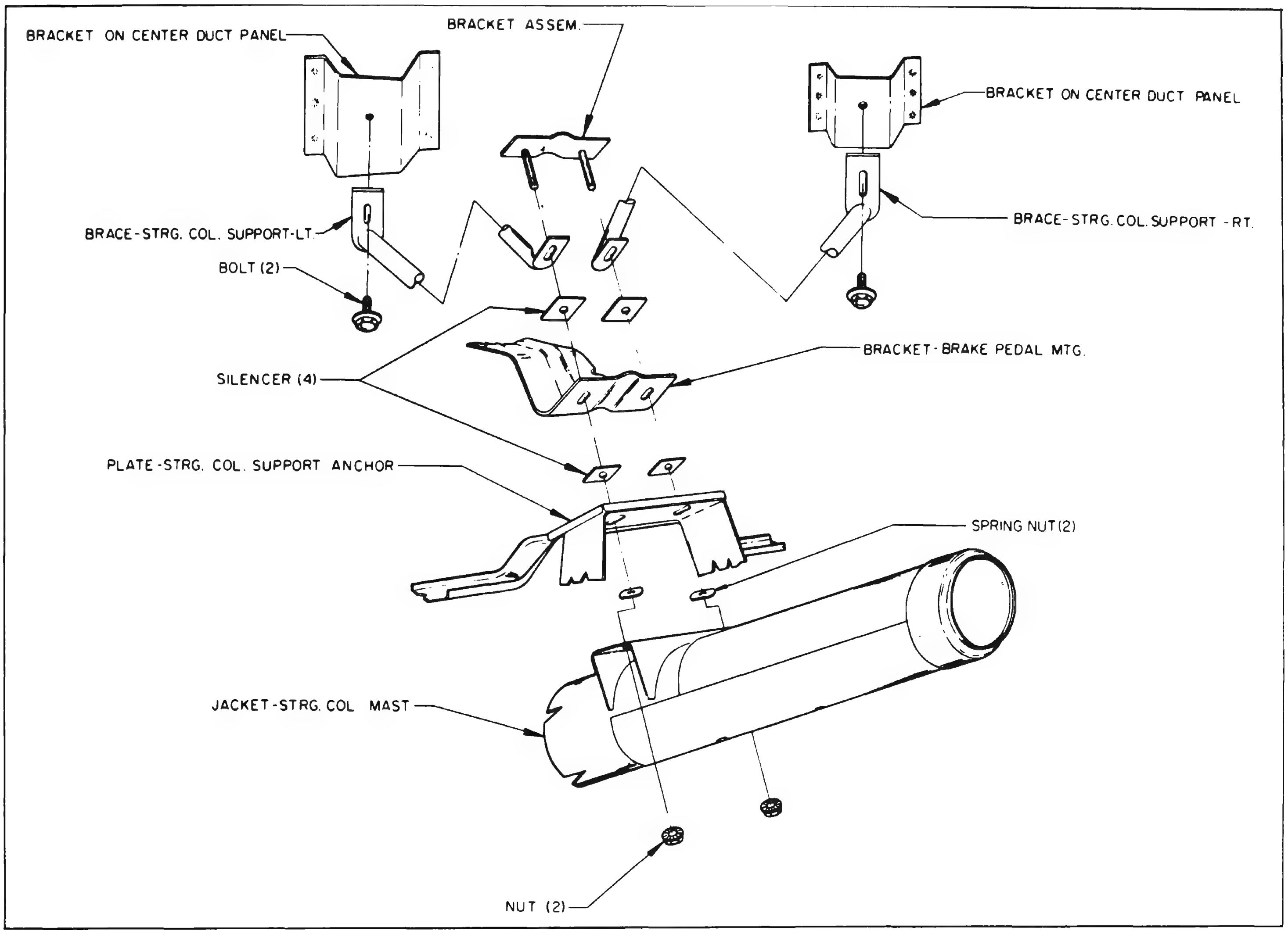


Figure 8-75—Steering Column Installation—Upper End

SECTION 8-D
MAST JACKET AND TILT STEERING WHEEL ASSEMBLIES

CONTENTS OF SECTION 8-D

8-22 REMOVAL AND INSTALLATION OF MAST JACKET ASSEMBLY

a. Removal

1. Disconnect ground strap from battery.

2. Disconnect rod from lower shift lever.

3. Remove lower coupling pinch bolt on power steering cars. On manual steering, remove bolt and nut that retain clamp to coupling and slide clamp off coupling.

4. Disconnect wiring harness connector from direction signal switch, horn wire that enters jacket and neutral safety switch.

5. Remove the two nuts that retain jacket to lower edge of instrument panel. See Figure 8-75.

6. Remove the screws that retain toe pan cover (located at lower end of jacket) to toe pan.

7. Carefully pull jacket assembly up and out of opening in toe pan.

CAUTION: Use care not to damage shift indicator pointer.

b. Installation

1. Position mast jacket assembly through opening in toe pan.

2. Install steering shaft lower coupling on steering gear shaft and install lower coupling bolt as shown in Figure 8-9 or 8-26.

3. Attach jacket to instrument panel and to toe pan. See Figure 8-75.

NOTE: On power steering, lower coupling pins should extend 1/16" to 1/8" through steering shaft flange when mast jacket is installed. See Figure 8-71. On manual steering, the lower end of jacket should be 1 3/8" from end of lower coupling on all cars, except 4400 Synchromesh cars. On 4400 Synchromesh cars, there should be 1 1/2". See Figure 8-72.

4. Install wiring connectors on switches on jacket and horn wire.

5. Connect battery ground cable.

6. Check neutral safety switch adjustment and adjust if necessary.

8-23 DESCRIPTION OF THE TILT STEERING WHEEL

The optional tilt steering wheel is designed to give ease of entry and driver comfort through six different steering wheel angle positions on the 4400, 4600 and 4800 Series and seven different steering wheel angle positions on the 4700 Series. The steering wheel is locked in the selected position by a lever located to the left of the steering column. See Figure 8-76. This lever is pulled toward the steering wheel to disengage the lock and allow positioning the wheel at the desired angle.

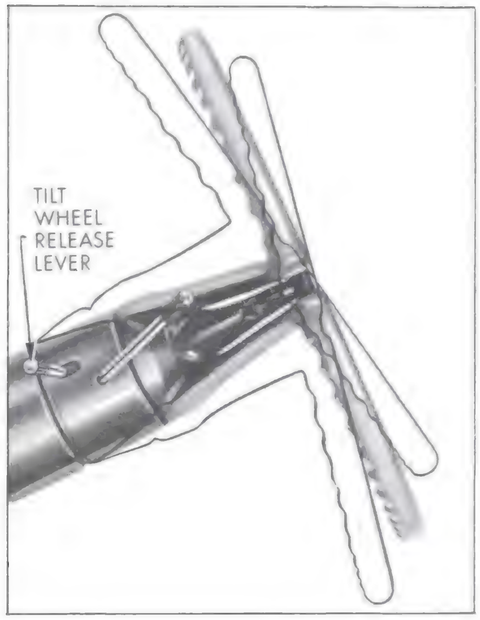


Figure 8-76—Tilt Steering Wheel Release Lever

The tilt steering assembly basically consists of an upper and lower steering shaft assembly with a universal type joint between them. See Figure 8-77. The joint has two Delrin spheres with a spring installed inside them to prevent any looseness in the joint. A support assembly is held to the mast jacket by a lock plate. The actuator is positioned over the upper steering shaft and is attached to the support by two pivot pins which allow up down motion between these parts. The upper and lower lock shoes which are retained to the actuator assembly, engage pins in the support. Two tilt springs are attached between the upper edge of the support and actuator.

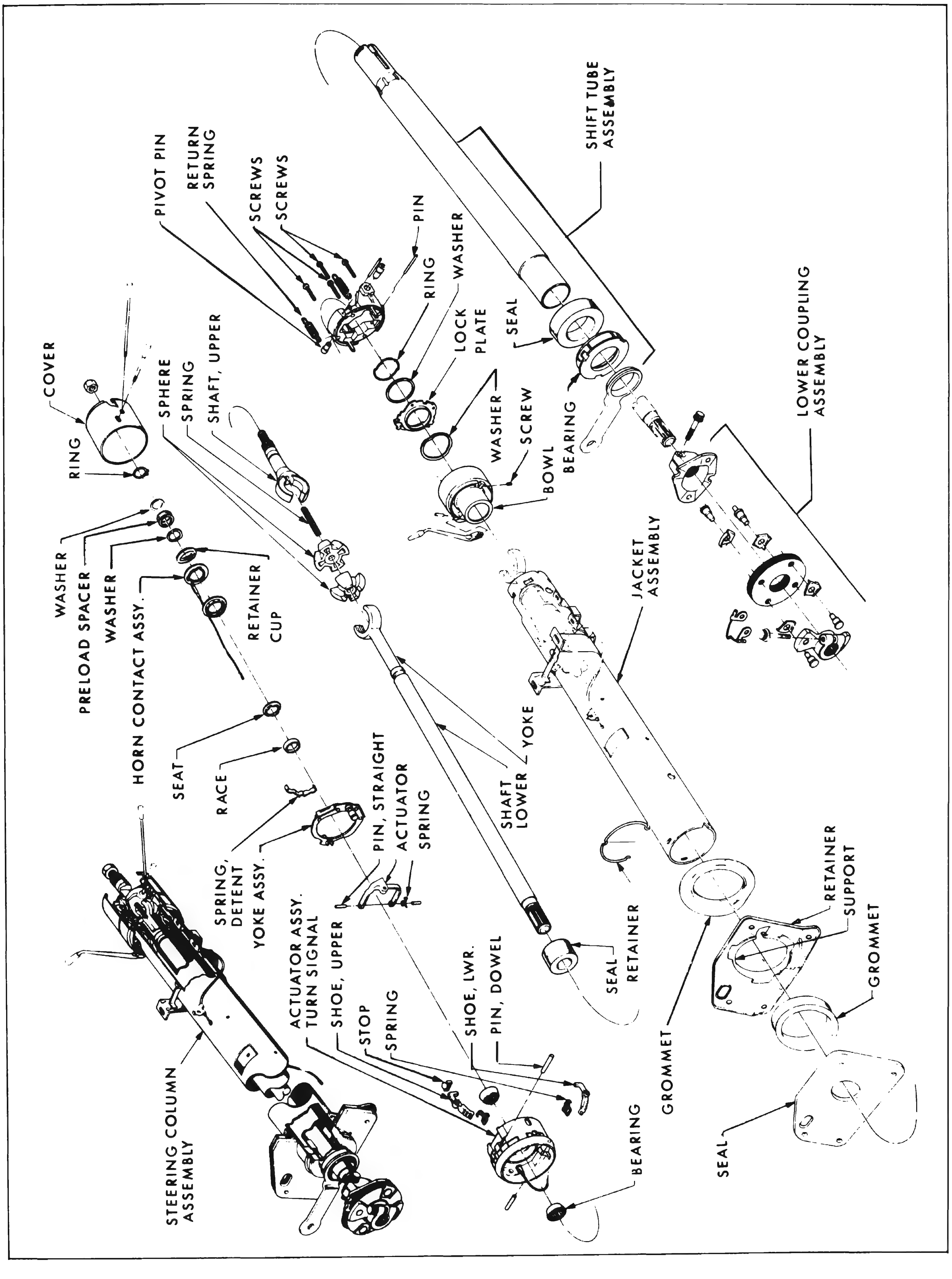


Figure 8-77—Exploded View of Tilt Steering Wheel

The upper shaft is secured in the actuator assembly by an upper and lower bearing. The bearings are preloaded by means of a bearing preload spacer. When the lever is released, the lock shoes will engage the pins in the support and hold assembly at angle desired.

When the tilt wheel release lever is moved upward the shoe release actuator causes the lock shoes to move inward and disengage the support. This allows the upper shaft which steering wheel is attached to and the actuator assembly to be set at a different position.

If no pressure is applied to the steering wheel when lever releases lock shoes, the tilt springs will position the steering wheel in its upper most position.

The 4400, 4600 and 4800 Series tilt wheel has a total of six positions. The 4700 tilt wheel has seven positions. Each position moves the steering wheel five degrees. The 4700 gains the extra position by use of a different upper lock shoe. This lock shoe allows the 4700 tilt wheel to move up one more position than the 4400, 4600 and 4800 tilt wheel.

8-24 TILT STEERING WHEEL SERVICE PROCEDURES

a. Removal of Actuator, Support and Steering Shaft Assemblies

The parts of the tilt wheel mechanism may be removed while the mast jacket assembly is installed in the car. If it is necessary to remove shift tube, the jacket assembly must be removed from car.

1. Remove steering wheel. Paragraph 8-5.

2. Remove direction signal switch from mast jacket. Disconnect control cable from switch.

3. Unplug horn ground wire connector where it enters mast jacket.

4. Carefully pry up horn contact and remove contact and wire from actuator.

5. Remove direction signal lever and tilt wheel release lever.

6. Remove actuator cover.

(a) Place Remover J-2180 inside cover.

(b) Thread two J-7004 slide hammers into J-21180 and carefully remove cover by applying force to one slide hammer at a time. See Figure 8-78.

7. Remove the upper shaft retainer ring using #2 Truarc Pliers J-4880. See Figure 8-79.

8. Remove washer, bearing preload spacer, rubber washer, retainer cup, seat, bearing inner race and upper bearing. See Figure 8-90. Discard preload spacer.

9. Remove turn signal detent spring and carefully remove actuator yoke.

10. Reinstall tilt release lever and position actuator assembly at the extreme up position.

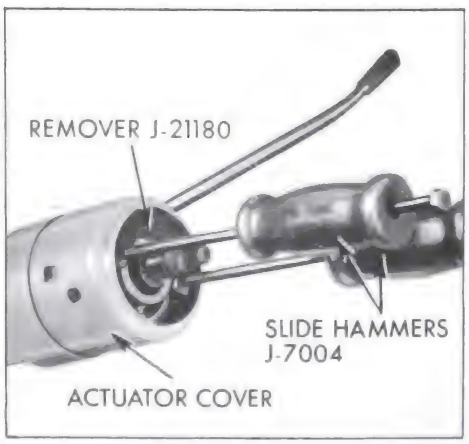


Figure 8-78—Removing Actuator Cover

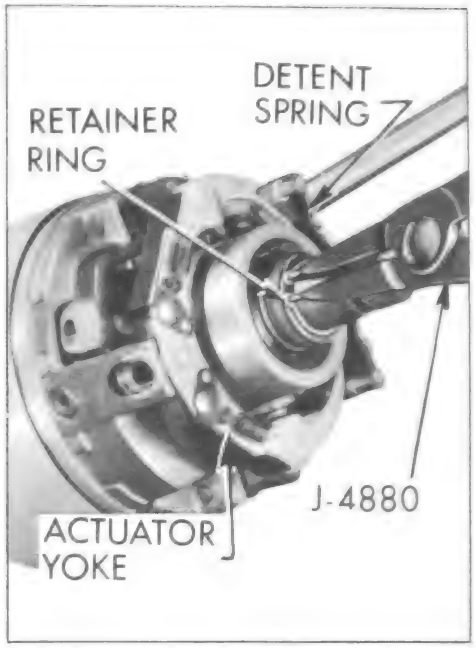


Figure 8-79—Removing Retainer Ring

11. Unhook upper ends of tilt springs by inserting a screwdriver in top coil of spring and prying upward, then disengage top loop of spring with another screwdriver. See Figure 8-80. View A shows removing spring on left side and View B shows removing spring on right side.

12. Remove the two pivot pins with Remover J-21179. See Figure 8-81. Thread stud of J-21179 into pin. Position remover as shown so that shift lever bowl will not be damaged. Hold stud and turn nut to remove pin.

13. Lift tilt wheel release lever to disengage lock shoes from the support and remove actuator assembly. See Figure 8-82. Remove tilt springs.

14. Remove lower bearing from steering shaft.

15. From the engine compartment remove the upper pinch bolt from the lower steering shaft flange.

16. Remove steering shaft assembly by pulling it up and out of mast jacket.

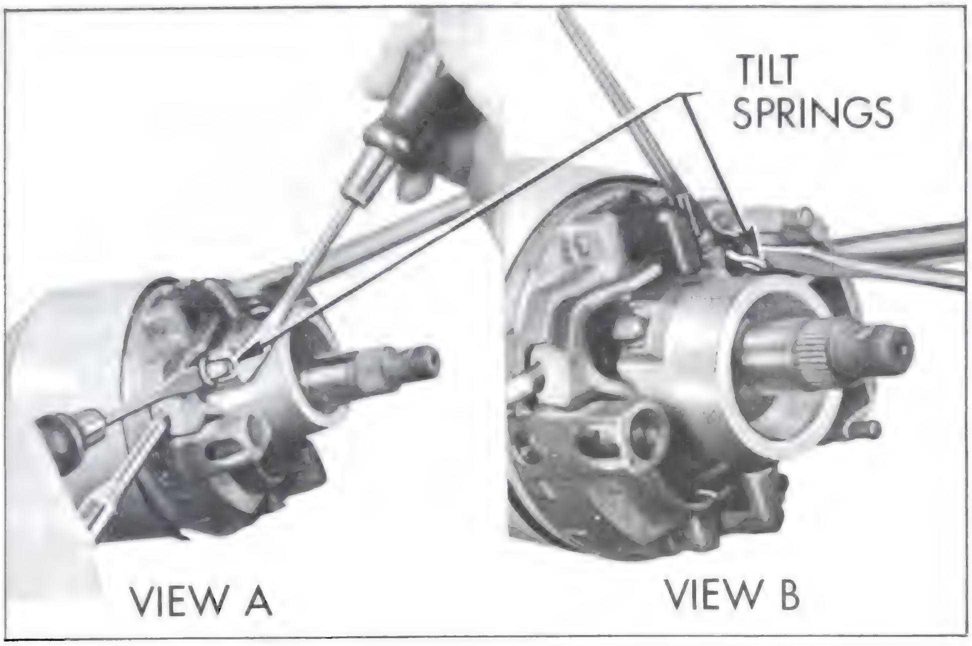


Figure 8-80—Removing Tilt Springs

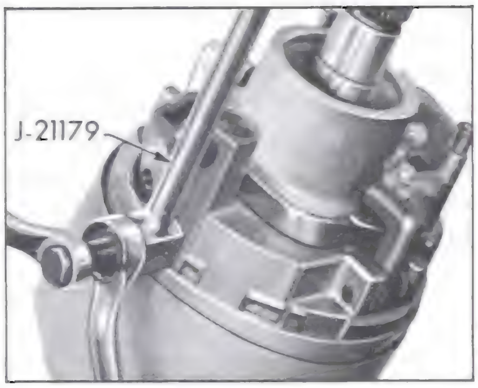


Figure 8-81—Removing Pivot Pin

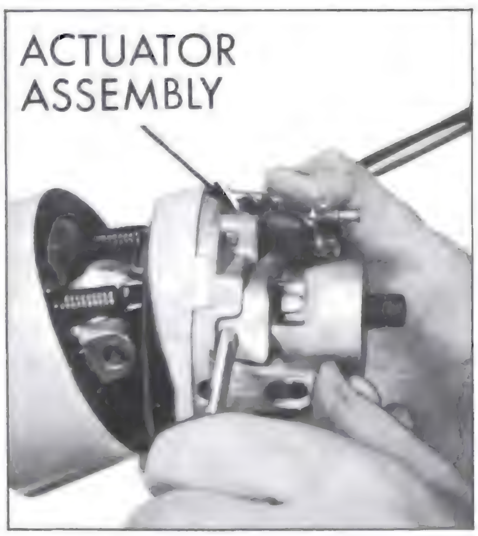


Figure 8-82—Removing Actuator Assembly

17. Remove the four support screws and then lift support off jacket.

b. Removal of Shift Bowl and Shift Tube

1. Remove mast jacket assembly from car. Paragraph 8-22.

2. Remove actuator, support and steering shaft assemblies from mast jacket. Subparagraph a.

3. Remove the shift tube retainer ring and washer from the top of shift tube. See Figure 8-83.

4. Remove the shift tube bearing retainer from the lower end of the mast jacket.

5. Remove the shift tube downward through column with two Slide Hammers J-7004 and Tool J-21180, driving against lower shift lever. See Figure 8-84.

6. Remove lock plate, wave washer and shift bowl from upper end of the mast jacket.

c. Assembly of Shift Bowl and Shift Tube

1. Install shift bowl on the mast jacket, then the wave washer lubricated with front wheel bearing lube over the mast jacket and then slide the lock plate into position through the opening in the mast jacket.

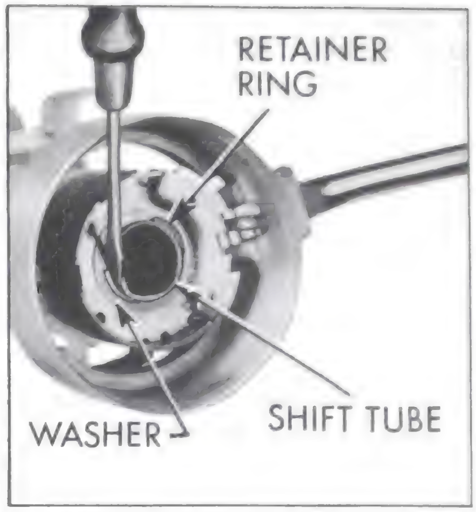


Figure 8-83—Removing Shift Tube Retainer Ring

2. Install the shift tube assembly with felt seal into the mast jacket from the lower end of the jacket.

3. Position the Delrin bearing into the lower end of the mast jacket so that slots in bearing line up with openings in jacket and install the retaining ring.

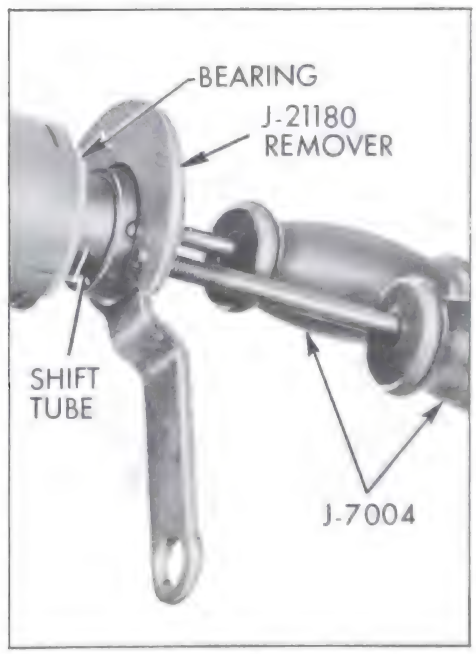


Figure 8-84—Removing Shift Tube

4. Apply lube to thrust washer and install the washer and retaining ring on the upper end of the shift tube.

5. Install steering shaft support and actuator assemblies in mast jacket. Subparagraph f.

6. Install mast jacket in car. Subparagraph 8-22.

d. Disassembly and Assembly of Actuator Assembly

The actuator, lock shoes and springs may be replaced separately. The shoe release actuator is serviced only with the actuator. See subparagraph a for removal of these parts.

1. Drive lock shoe pins out of actuator and remove shoes and springs. The upper shoe has a rubber stop on it. See Figure 8-85.

2. If necessary remove control cable from actuator.

3. If removed, install the turn signal switch control cable on the bell crank in the turn signal actuator mounting cable loop inboard. Install cable bracket screw.

4. If lock shoes were removed from actuator, install the springs on the upper end over lock shoes, then install the shoes in the actuator and retain with the pins. See Figure 8-86.

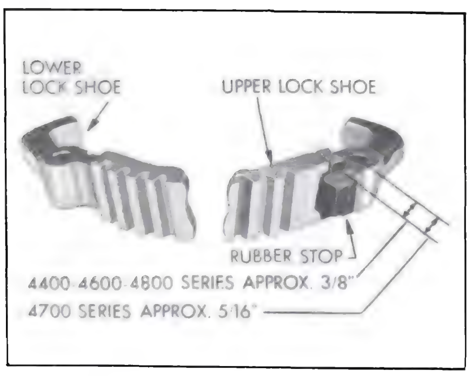


Figure 8-85—Lock Shoes

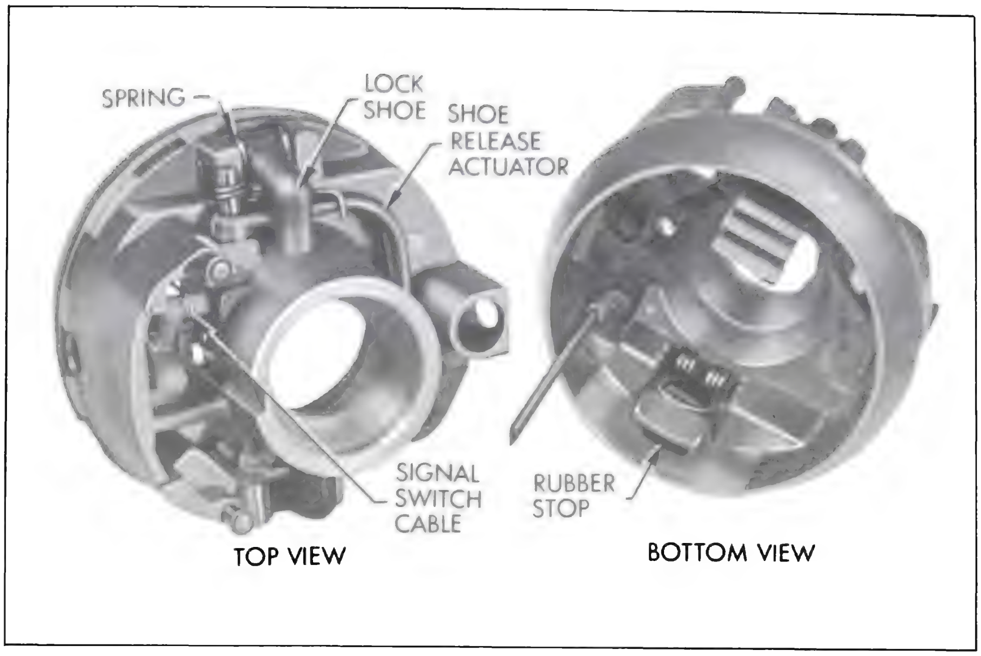


Figure 8-86—Actuator Assembly

NOTE: The upper lock shoe must have the rubber stop installed.

e. Disassembly and Assembly of Steering Shaft Assembly

See subparagraph a for removal of shaft assembly.

1. Turn upper shaft slightly from centerline of lower shaft.

2. Using a narrow bladed screwdriver, compress joint preload spring enough to remove from upper shaft, then remove spring from centering spheres. See Figure 8-87.

3. Turn upper shaft 90° from centerline of lower shaft and remove shaft over flats of centering sphere.

4. Remove the sphere from the upper shaft by rotating so sphere flats align with shaft socket.

5. Apply front wheel bearing lube to the centering spheres and the steering shaft sockets.

6. Place the centering spheres in the upper shaft socket.

7. Turn the spheres so the lower shaft can be installed over the flat area of the spheres. (Approximately 90° from centerline of lower shaft.) Then install lower shaft socket over the sphere so that locating mark on end of upper shaft is on same side as flat on lower shaft.

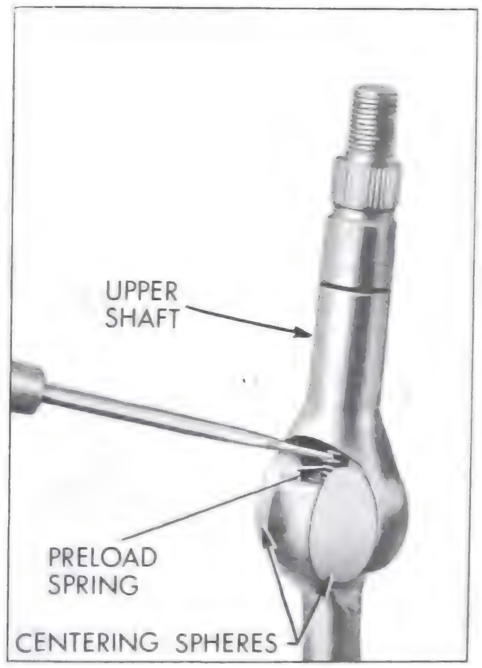


Figure 8-87—Removing Joint Preload Spring

8. Insert the joint preload spring through centering spheres into lower shaft. Using the upper shaft to hold the spring in place and a screwdriver in the other hand, carefully feed spring into shaft joint. See Figure 8-88.

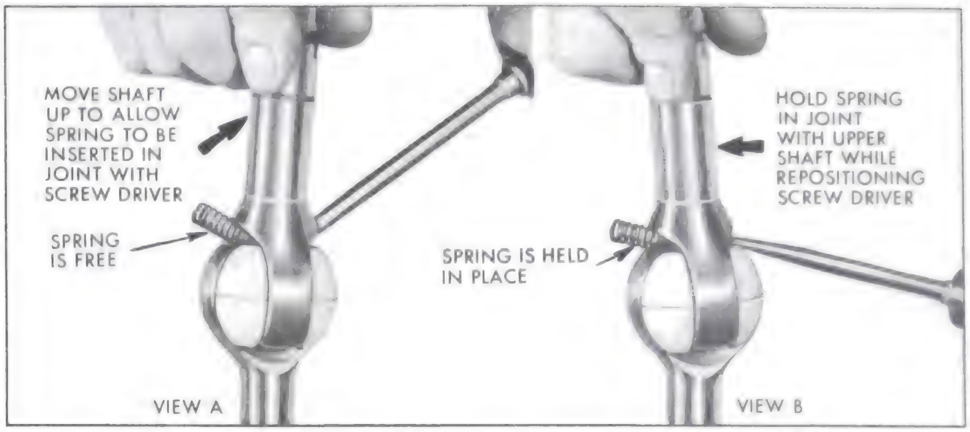


Figure 8-88—Installing Joint Preload Spring

f. Installation of Support, Steering Shaft and Actuator Assemblies

When assembling parts, apply a thin coat of front wheel bearing lube to all friction parts.

1. Install the support on the upper end of the mast jacket and install the four attaching support screws. Torque screws to 25 in. lb. Torque larger screws first.

2. Install the steering shaft assembly into the mast jacket.

3. Install steering shaft seal on lower end of steering shaft.

4. Place the lower bearing on upper steering shaft.

5. Snap the lower ends of the two tilt springs on the support spring anchor.

6. Install the tilt lever into the lock shoe release actuator and install horn wire and contact assembly in actuator assembly.

7. Apply front wheel bearing lube on lock shoes and on frictional surfaces at actuator assembly including surfaces where actuated contacts support. Move the tilt lever up slightly to prevent the lock shoes from engaging the support pins, then install the actuator assembly over the steering shaft, carefully feeding horn and control wire through shift bowl. Position actuator assembly on support. See Figure 8-82.

8. Apply lube to pivot pins. Align the actuator assembly pivot pin holes with the holes in the support assembly and install pivot pins. Pins should be flush with edge of actuator.

9. Raise tilt release lever and position actuator at extreme up position.

10. Install the upper ends of the two tilt springs using Tool J-21181 spring installer. See Figure 8-89.

11. Install the turn signal actuator yoke and detent spring. Be sure yoke engages turn signal cable operating lever in actuator.

12. Install the upper steering shaft bearing, bearing inner race, seat, retainer cup (lip side up), rubber washer, new bearing preload spacer, washer and retainer ring on upper steering shaft. See Figure 8-90.

13. Using the #2 Truarc Pliers J-4880, install the retainer ring on upper shaft. Place Installer J-21179 with cut out or slot on retainer ring as shown in Figure 8-91. Install the steering shaft nut and tighten until the cut out in J-21179 is in line with the upper edge of the retainer ring groove in shaft. See Figure 8-91. Remove nut and J-21179 and allow ring to seat in groove in shaft.

IMPORTANT: Care must be used when compressing preload spacer in Step 13 so that bearings will be properly preloaded.

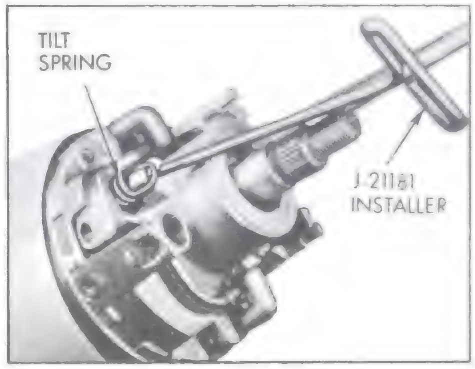


Figure 8-89—Installing Tilt Springs

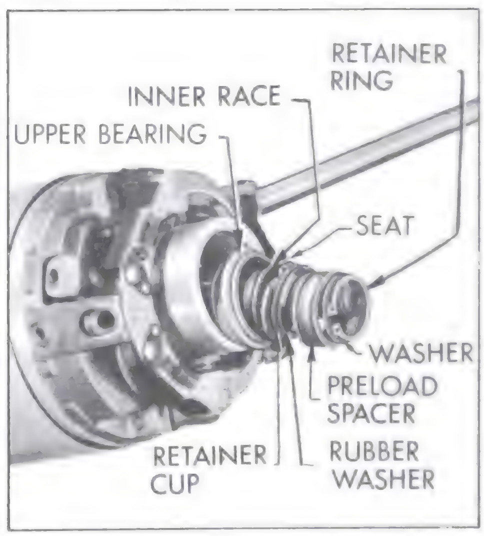


Figure 8-90—Installing Bearing Preload Parts

NOTE: If mast jacket is removed or lower end of steering shaft is free, check torque of steering

Figure 8-91—Compressing Preload Spacer

shaft to see if bearing preload is correct using Torque Wrench J-5853. Torque should be 35 to 45 inch ounces in all tilt wheel positions. If torque is too high, remove retainer ring from upper shaft and repeat Step 13 being sure to properly compress spacer. If torque is too low, obtain another new bearing preload spacer and properly install being careful not to over compress spacer.

14. Seat horn contact in actuator. Coat contact ring with lubriplate.

15. Remove tilt release lever. Align the actuator cover so that tang on cover lines up with its slot in actuator. Carefully install cover on actuator using a block of wood.

16. Install the tilt release and direction signal turn levers in actuator.

17. Plug horn wire together at mast jacket.

18. Install steering wheel. Paragraph 8-5.

19. Install direction signal switch as follows:

a. Position tilt wheel in full down position. Locate switch pin in center position.

b. Place direction signal lever in off position, then install control wire loop over switch operating pin.

c. Attach cable wire clamp to switch.

d. Assemble switch to mast jacket.

20. Install lower coupling pinch bolt and tighten to 25 ft. lbs.

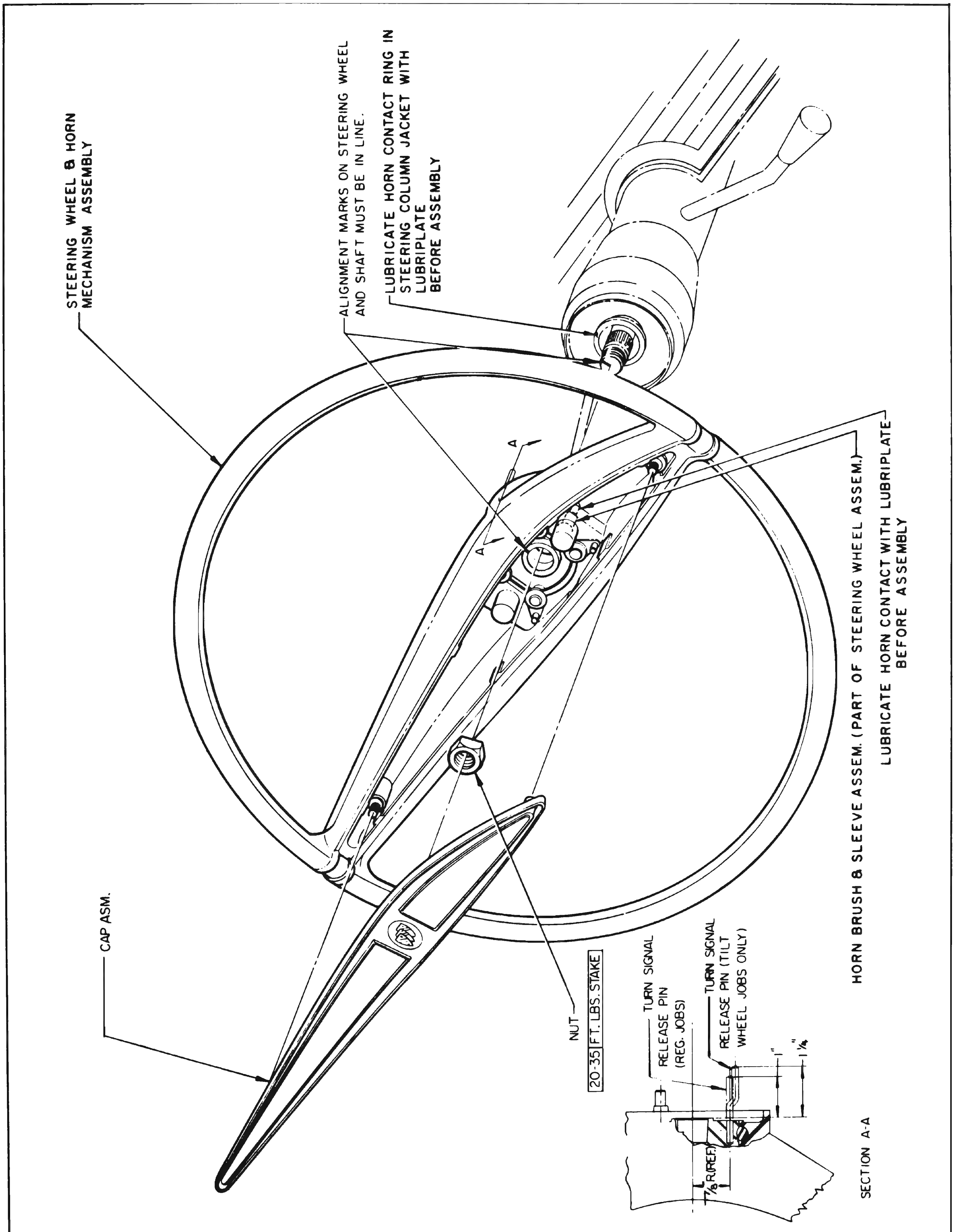


Figure 8-92—Steering Wheel Installation

GROUP 9

BRAKES

SECTIONS IN GROUP 9

SECTION 9-A

BRAKE SPECIFICATIONS, DESCRIPTION, OPERATION

CONTENTS OF SECTION 9-A

9-1 BRAKE SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the parts listed, to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

	Name	Thread Size	Torque-Ft. Lbs.
Nut	Brake Pedal Pivot Shaft to Mounting Bracket	5/16-24	10-15
Screw	Wheel Cylinder to Brake Backing Plate	5/16-18	10-15
Nut	Brake Cylinder and Pedal Mounting Bracket to Dash (Standard and Power)	3/8-16	20-28
Bolt & Nut	Brake Assembly and Steering Arm to Knuckle, Front	7/16-14	60-85
Nut	Rear Brake Assembly to Axle Housing	3/8-16	40-55
Bolt & Nut	Brake Assembly and Steering Arm to Knuckle, Rear	1/2-13	90-120
Bolt	Brake Assembly through Anchor Pin to Knuckle	9/16-18	130-150
Nut	Front Wheel to Hub	1/2-20	65-85
Nut	Rear Wheel and Brake Drum to Axle Shaft	1/2-20	65-85

b. General Specifications

Items	
Operating Mechanism, Service Brakes	Hydraulic
Parking Brakes	Lever and Cables
Operation of Service Brakes Independent of Parking Brakes	Yes
Wheels Braked, Service	Front and Rear
Parking	Rear Only
Approx. % of Total Braking Power on—Front Wheel Brakes	56
Rear Wheel Brakes	44

b. General Specification (Cont'd)

Items	
Brake Pedal Height Adjustment, Standard and Power	None
Static Pressure in Hydraulic System when Brakes are Released	8 to 16 lbs.
Number of Brake Shoes at Each Wheel	2
Brake Type	Self Energizing-Servo
Brake Shoe Lining Type	1 pc. Molded-Riveted
Front Shoe Lining Width x Minimum Thickness	2.25" x .220"
Rear Shoe Lining Width x Minimum Thickness	2.00" x .220"
Front Brake Drum, All Series	Finned Aluminum with C.I. Liner
Master Cylinder Piston Dia., Standard and Power	1"
Wheel Cylinder Size, Front	1 1/8"
Rear	1"
Approved Hydraulic Brake Fluid	GM or Delco Super No. 11 or equiv.
Fluid Level, Below Lip of Reservoir Opening	1/8"
Shoe Adjusting Screw Setting, from Point where Wheels can just be turned by hand	Back Off 15 Notches
Brake Drum Inside Diameter, New	11.997" to 12.007"
Brake Drum Rebore, Max. Allowable Inside Diameter	12.080"
Max. Allowable Taper, Before Rebore	.005"
Max. Allowable Out-of-Round, Before Rebore	.010"
Max. Allowable Out-of-Balance of Drum	3 in. oz.
Max. Allowable Space Between Lining and Shoe Rim after Riveting	.005"

9-2 DESCRIPTION OF BRAKE MECHANISM

The brake mechansim includes a brake drum and a brake assembly at each wheel, and two separate and independent control systems for applying the brakes-- (1) Parking brake control system (2) Service brake control system with self-adjusting mechanism.

a. Wheel Brake Assemblies

All rear brake drums consist of a cast iron rim fused to a pressed steel disk. The cast iron rim provides an ideal braking surface and increases brake lining life. External ribs and fins aid in dissipation of heat.

All front brake drums are cast aluminum alloy with a cast iron liner. The aluminum section has cast ribs and fins to help dissipate heat to the air.

The brake assembly at each wheel uses a primary (front) and secondary (rear) brake shoe of welded steel construction, with one-piece molded lining attached by tubular rivets. The primary shoe lining is shorter than the secondary shoe lining and is of different composition; therefore the two shoes are not interchangeable. See Figure 9-1.

Each brake shoe is held against the backing plate by a hold-down spring, pin, and cup which allow free movement of the shoe. The notched upper end of each shoe is held against the single fixed anchor pin by a heavy coil spring. An adjusting screw and lock spring connects the lower ends of both shoes together and provides adjustment for clearance with the brake drum.

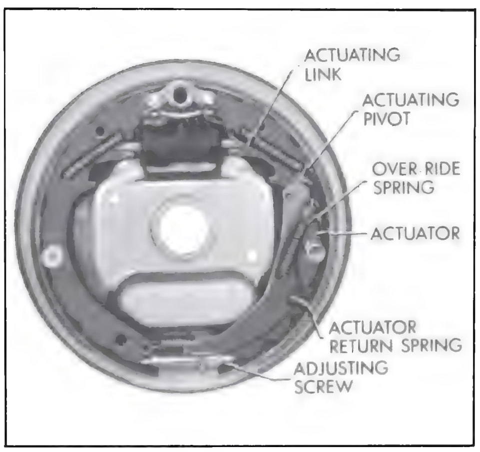


Figure 9-1—Right Rear Wheel Brake Assembly

A hydraulic wheel cylinder mounted on the backing plate between the upper ends of the brake shoes forces the shoes against the brake drum when the service brakes are applied. On rear wheels only, a lever mounted on each secondary shoe and connected to the primary shoe by a strut is used for applying the shoes when used as parking brakes. See Figure 9-1.

When the brake shoes contact the rotating drum, in either direction of car travel, they move with the drum until the rearward shoe is stopped by the anchor pin and the forward shoe is stopped by the rearward shoe through the connecting adjusting screw. Frictional force between drum and shoe lining tires to rotate each shoe outward around its anchor point but the drum itself prevents this rotation; consequently the shoes are forced more strongly against the drum than the applying force is pushing them. See Figure 9-2. It is also evident that the force applied by the drum to the forward shoe is imparted to the rearward shoe through the connecting adjusting screw.

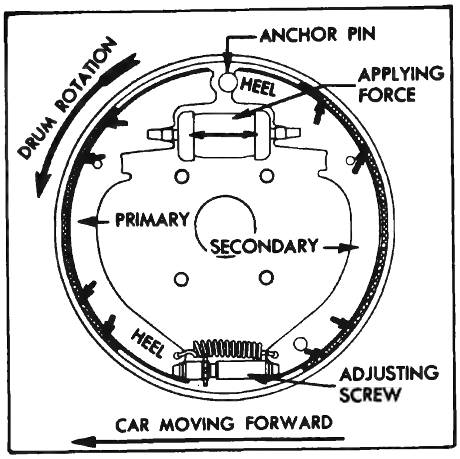


Figure 9-2—Brake Shoe Action

Utilization of the frictional force to increase the pressure of shoes against the drum is called self-energizing action. Utilization of force in one shoe to apply the opposite shoe is called servo action.

b. Parking Brake Control System

The parking brake control system uses a foot-operated brake lever, conduit enclosed cables, an idler lever, brake shoe levers and struts to apply the rear wheel brakes only. See Figures 9-3, and 9-4.

The foot-operated parking brake is connected with a parking brake lever cable to an idler lever located between the frame rails just forward of the frame tunnel. An adjustable clevis at the rear end of this cable is used to properly position the idler lever. A return spring returns the idler lever to its rearward position and, at the same time, returns the cable and parking brake lever to the released position. An equalizer is connected to the center of the idler lever and a ball on the forward end of each rear cable engages a slot in this equalizer.

The rear end of each rear brake cable is attached to the free lower end of a brake shoe lever pivoted on each secondary (rear) brake shoe. A strut is mounted between each brake shoe lever and the primary (front) brake shoe. See Figure 9-1.

When the foot-operated brake lever is pushed forward the cables apply an equal pull to each brake shoe lever, and the levers and struts force all rear brake shoes into firm contact with the brake drums. A spring-loaded latch automatically locks the brake lever to keep the parking brakes applied. The brake lever is released by pushing downward on the release knob. A warning

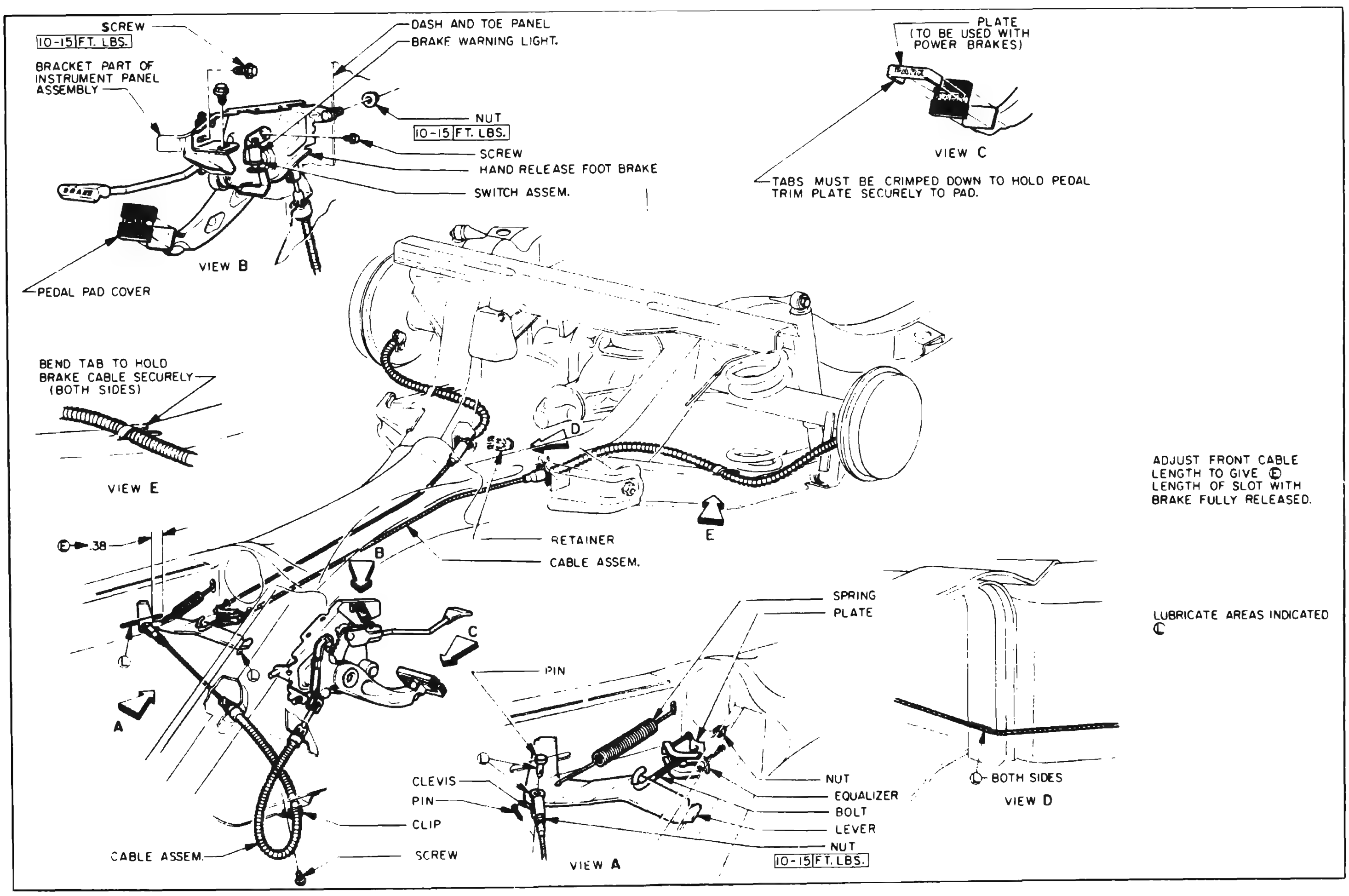


Figure 9-3—Parking Brake Mechanism - 44-46-4800 Series

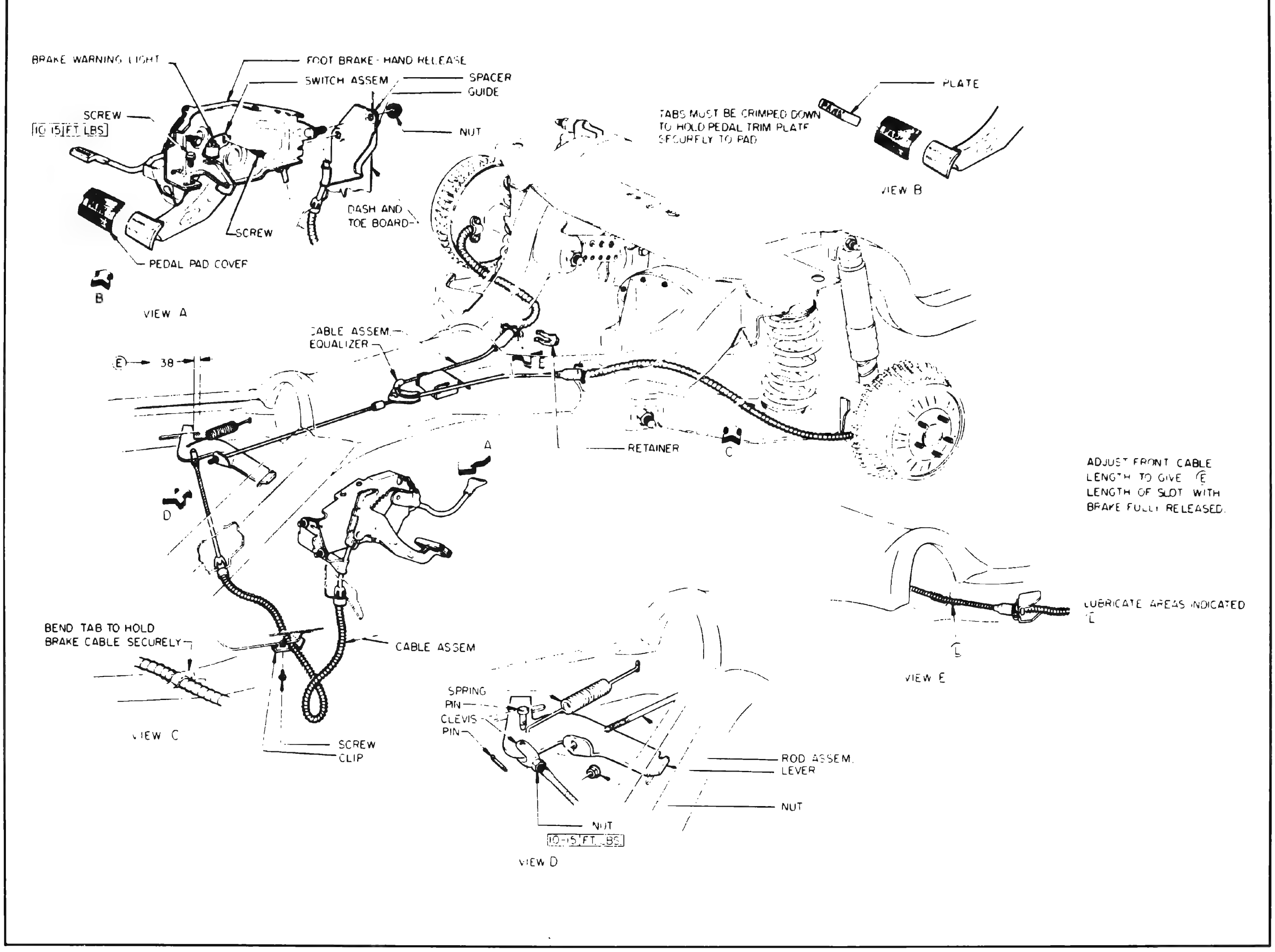


Figure 9-4—Parking Brake Mechanism 4700 Series

signal, which is standard on Series 4800 and optional on Series 4400-4600, will show a red light on instrument panel if the car is operated with the parking brakes applied.

c. Service Brake Control System—Standard Brakes

NOTE: See paragraph 9-14 for power brakes.

The regular foot-powered service brake control system is a pedal operated hydraulic system which applies the brakes at all four wheels with equalized pressure.

The hydraulic system consists of one master cylinder connected by pipes and flexible hoses to a wheel cylinder mounted between the brake shoes at each wheel. The master cylinder, pipes, hoses and four wheel cylinders are filled with brake fluid. The stop light switch is mounted on a bracket just rearward of the brake pedal shank. With the brakes fully released, the switch plunger is fully depressed against an operating plate on the pedal shank. See Figures 9-7 and 9-8. A coiled brake pipe extends downward from the master cylinder to a distributor located on the left frame rail. A brake pipe extends rearward from the distributor to a union inside the left frame rail. From the union a pipe extends to a bracket on the rear spring cross member. At that point it connects to a flexible hose which is connected to a tee located on the axle housing. Two pipes lead off from the tee, one to the left rear wheel cylinder and the other to the right rear wheel cylinder. See Figures 9-5 and 9-6.

The brake pedal is suspended from a pivot shaft in the pedal bracket. The master cylinder push rod clevis attaches directly to the shank of the pedal. The overall mechanical advantage in the standard brake linkage is 6 to 1. See Figures 9-7, and 9-8.

The pivot shaft in the brake pedal has nylon bushings which are lubricated during installation but do

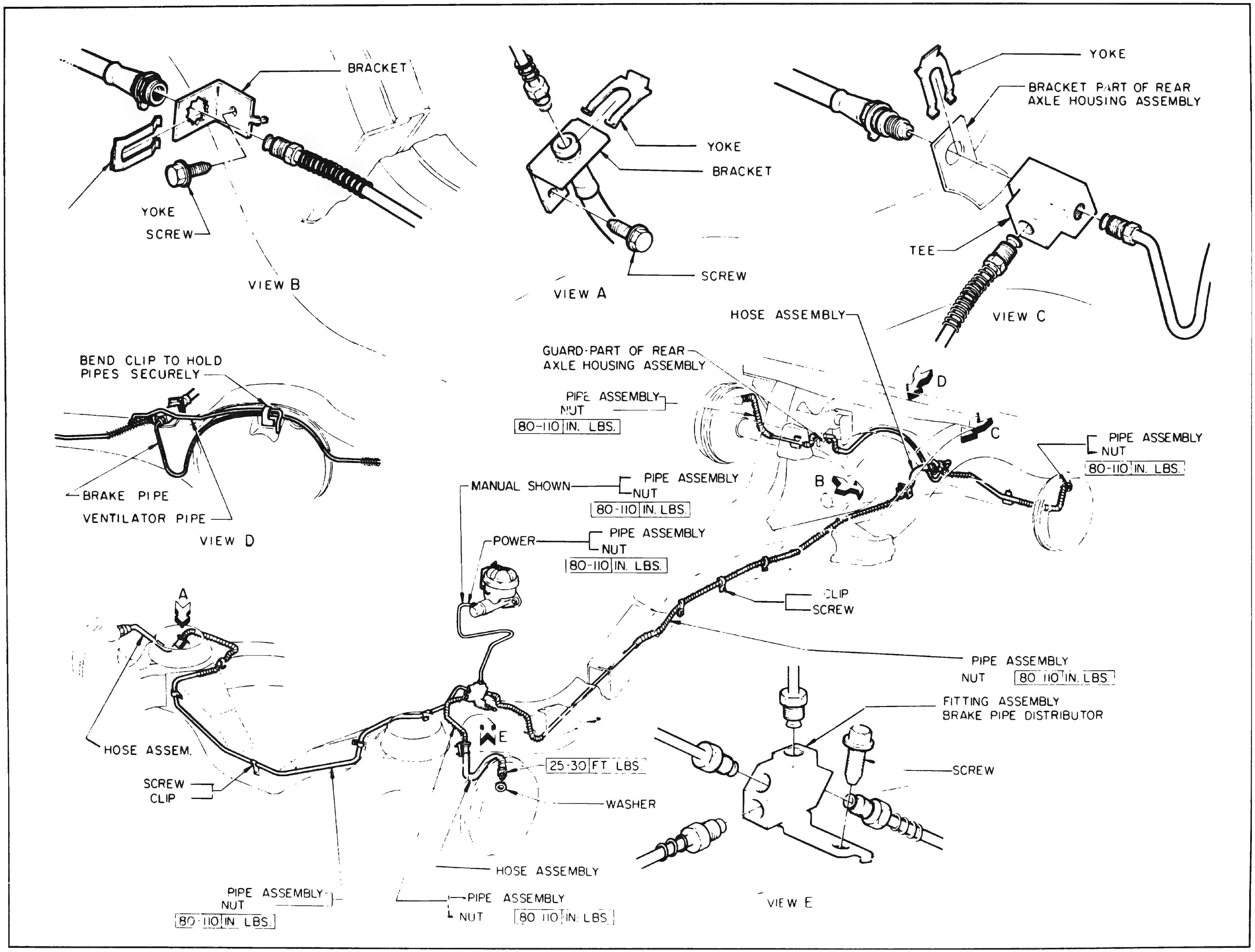
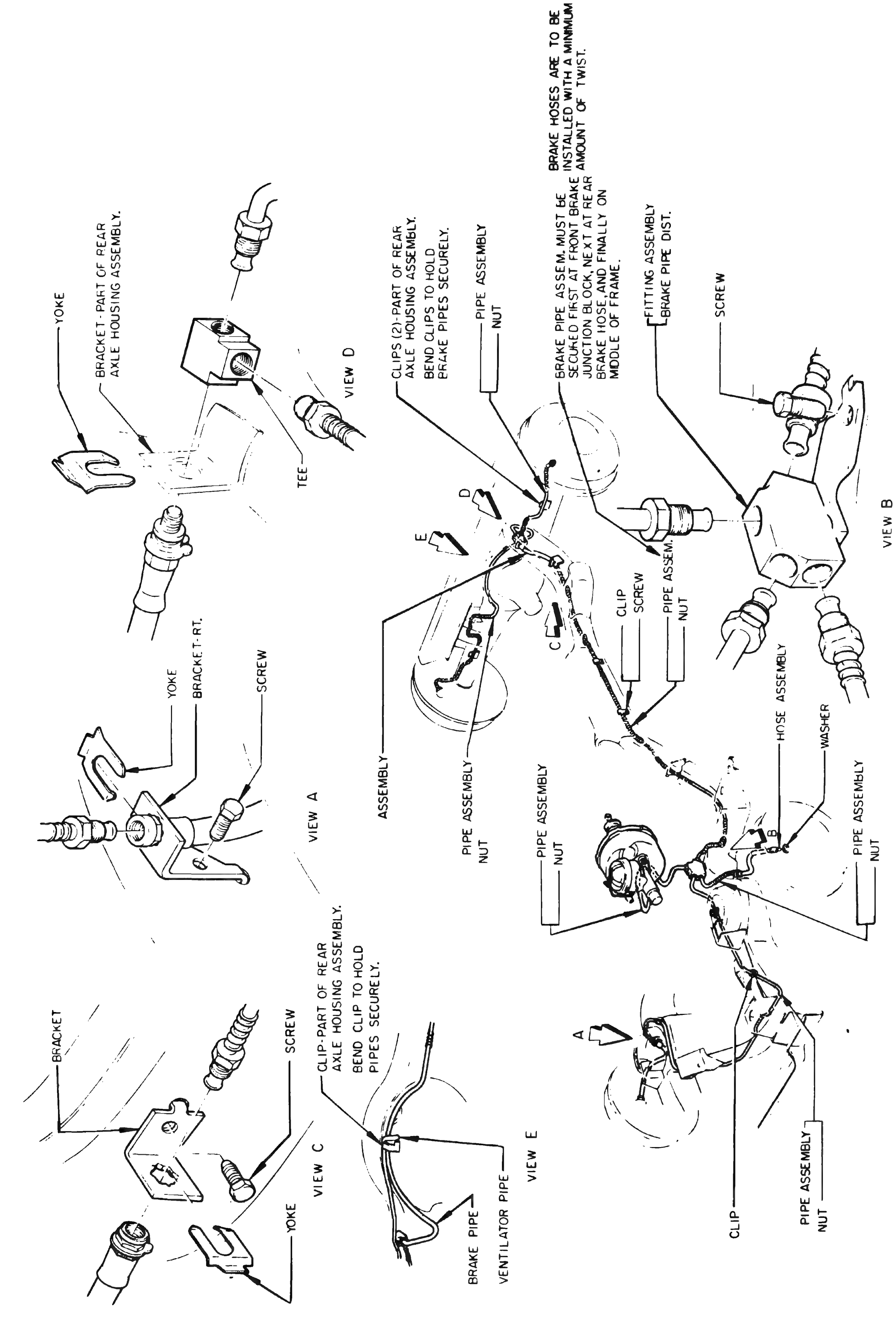


Figure 9-5—Service Brake Control System 4400-4600 & 4800 Series


YOKE
BRACKET-PART OF REAR AXLE HOUSING ASSEMBLY.
TEE
VIEW D
CLIPS (2)-PART OF REAR AXLE HOUSING ASSEMBLY.
BEND CLIPS TO HOLD BRAKE PIPES SECURELY.
PIPE ASSEMBLY
NUT
BRAKE PIPE ASSEM. MUST BE SECURED FIRST AT FRONT BRAKE JUNCTION BLOCK, NEXT AT REAR BRAKE HOSE, AND FINALLY ON MIDDLE OF FRAME.
BRAKE HOSES ARE TO BE INSTALLED WITH A MINIMUM AMOUNT OF TWIST.
FITTING ASSEMBLY
BRAKE PIPE DIST.
SCREW
VIEW B
YOKE
BRACKET-RT.
SCREW
VIEW A
ASSEMBLY
PIPE ASSEMBLY
NUT
E
D
C
CLIP
SCREW
PIPE ASSEM.
NUT
HOSE ASSEMBLY
WASHER
B
PIPE ASSEMBLY
NUT
PIPE ASSEMBLY
NUT
CLIP-PART OF REAR AXLE HOUSING ASSEMBLY.
BEND CLIP TO HOLD PIPES SECURELY.
BRACKET
SCREW
YOKE
VIEW C
A
BRAKE PIPE
VENTILATOR PIPE
VIEW E
CLIP
PIPE ASSEMBLY
NUT

not require periodic lubrication. Whenever the linkage is disassembled, however, all friction surfaces should be lightly coated with Lubriplate. Because there is no pedal stop, the pedal is stopped in the "off" position by contact of the push rod with the stop plate in the master cylinder. No linkage adjustment is possible; therefore pedal height cannot be changed.

The master cylinder contains a fluid reservoir and a cylindrical pressure chamber in which force applied to the brake pedal is transmitted to the fluid which actuates the brake shoes. Between the pressure chamber and the fluid reservoir, a breather port and compensating port permit passage of fluid during certain operating conditions. A vented cover and flexible rubber diaphragm, at the top of the master cylinder reservoir, seal the hydraulic system from possible entrance of contamination, while at the same time permitting expansion or contraction of fluid within, the reservoir without direct venting. In the pressure chamber, a coil spring holds a rubber primary cup against the inner end of the piston. This cup and a rubber secondary seal on the outer end of the piston prevent escape of fluid past the piston. The piston is retained in the cylinder by a stop plate, and a rubber boot is installed over this end of the cylinder to exclude foreign matter.

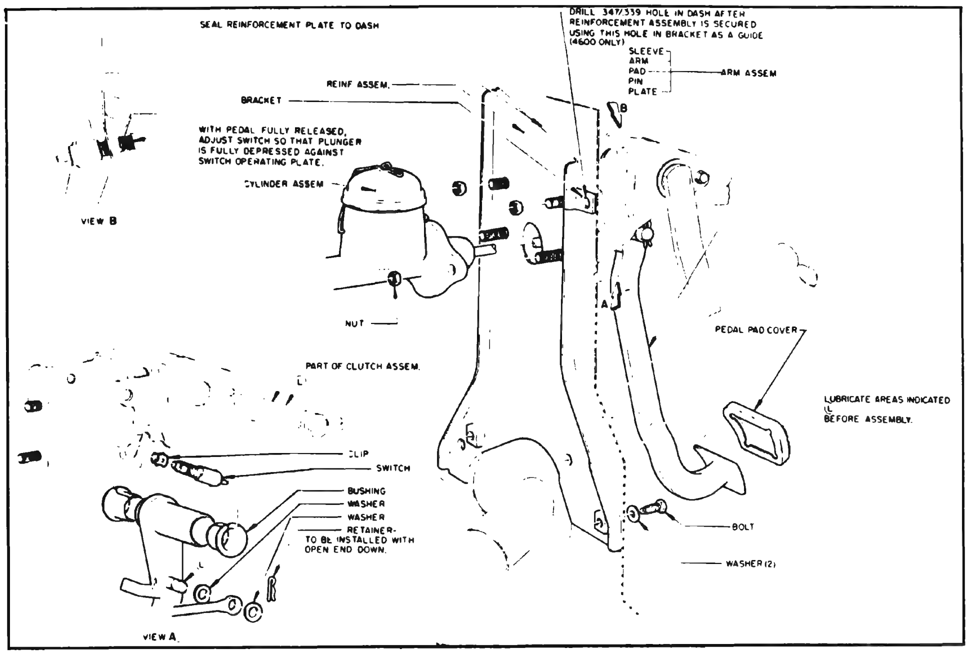


Figure 9-7—Standard Brake Pedal and Master Cylinder Installation (Synchromesh)

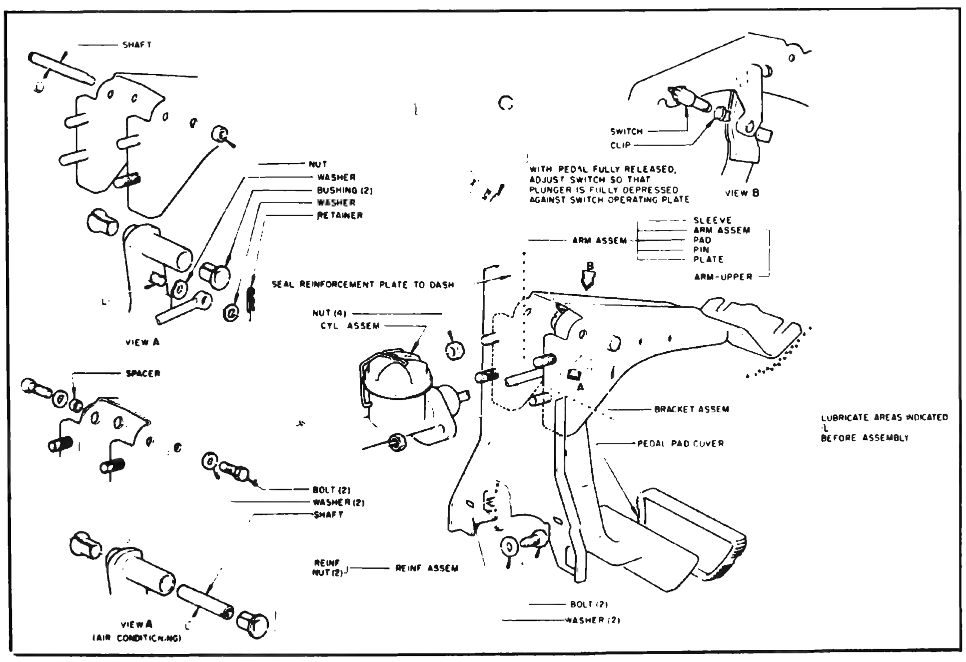


Figure 9-8—Standard Brake Pedal and Master Cylinder Installation (Automatic)

Each wheel cylinder contains two pistons and two rubber cups which are held in contact with the pistons by a central coil spring with cup expanders to provide a fluid-tight seal. The wheel cylinder cups are of a special heat resisting rubber. Cups of this material must have an expander to hold the lips of the cup out against the wheel cylinder bore. These cup expanders are crimped on each end of the wheel cylinder spring. The inlet port for brake fluid is located between the pistons so that when fluid pressure is applied both pistons move outward towards the ends of wheel cylinders. The pistons impart movement to the brake shoes by means of connecting links which seat in pistons and bear against webs of shoes. Rubber boots enclose both ends of cylinder to exclude foreign matter. A valve for bleeding the brake pipes and wheel cylinder is located above the inlet port.

d. Self Adjusting Brake

The self adjusting brake mechanism consists of an actuator,

actuator pivot, actuator return spring, override spring and an actuating link. See Figure 9-13. The self-adjusting brake mechanism is mounted on the secondary shoes and operates only when the brakes are applied while the car is moving in a rearward direction and only when the secondary shoe moves a predetermined distance toward the brake drum.

When the car is moved in a rearward direction and the brakes are applied, friction between the primary shoe and the drum forces the primary shoe against the anchor pin. Hydraulic pressure in the wheel cylinder forces the upper end of the secondary shoe away from the anchor pin, the upper end of the actuator is prevented from moving by the actuating link. This will cause the actuator to pivot on the secondary shoe forcing the actuator lever against the adjusting screw star wheel. If the brake linings are worn enough to allow the secondary shoe to move the predetermined distance, the actuator will turn the adjusting screw one tooth. If the secondary shoe does not move the predetermined distance, movement of the actuator will not be great enough to rotate the adjusting screw.

When the brakes are released, the actuator return spring will return the actuator into adjusting position on the adjusting screw.

9-3 OPERATION OF HYDRAULIC SERVICE BRAKES

NOTE: See paragraph 9-16 for power brakes.

When the brakes are fully released, the master cylinder piston is held against the stop plate and the primary cup is held just clear of the compensating port by the master cylinder spring, which also holds the check valve against its seat on the valve seat washer. The pressure chamber is filled with fluid at atmospheric pressure due to the open compensating port and reservoir rubber diaphragm. All pipes and wheel cylinders are filled with fluid under a "static" pressure of 8-16 pounds per square inch, which helps to hold the lips of the wheel cylinder cups in firm contact with cylinder walls to prevent loss of fluid or entrance of air. See Figure 9-9, View A.

When the brake pedal is depressed to apply the brakes, the push rod forces the master cylinder piston and primary cup forward. As this movement starts, the lip of the primary cup covers the compensating port to prevent escape of fluid into the reservoir. Continued movement of the piston builds pressure in the pressure chamber and fluid is then forced through holes in the check valve and out into the pipes leading to all wheel cylinders. Fluid forced into the wheel cylinders between the pistons and cups causes the pistons and connecting links to move outward and force the brake shoes into contact with the drums. See Figure 9-9, View B.

Movement of all brake shoes into contact with drums is accomplished with very light pedal pressure. Since pressure is equal in all parts of the hydraulic system, effective braking pressure cannot be applied to any one drum until all of the shoes are in contact with their respective drums; therefore the system is self-equalizing. After all shoes are contacting the drums, further force on brake pedal builds up additional pressure in the hydraulic system, thereby increasing the pressure of shoes against drums.

On rapid stops some car weight is transferred from the rear to the front wheels, consequently greater braking power is required at front wheels in order to equalize the braking effect at front and rear wheels. Greater force is applied to front brake shoes by using larger wheel cylinders, so that distribution of braking power is approximately 56% at front wheels and 44% at rear wheels.

When the brake pedal is released, the master cylinder spring forces the pedal back until the push rod contacts the stop plate in master cylinder. This spring also forces the piston and primary cup to follow the push rod and presses the check valve firmly against its seat.

At start of a fast release the piston moves faster than fluid can follow it in returning from the pipes and wheel cylinders, therefore, a partial vacuum is momentarily created in the pressure chamber. Fluid supplied through the breather port is then drawn through the bleeder holes in piston head and past the primary cup to keep the pressure chamber filled. See Figure 9-9, View C.

As pressure drops in master cylinder, the shoe springs retract all brake shoes and the connecting links push the wheel cylinder pistons inward, forcing fluid back to master cylinder. Pressure of returning fluid causes a rubber disc to close all holes in the check valve and forces the check valve off its seat against the tension of master cylinder spring; fluid then flows around the check valve into the pressure chamber. With the piston bearing against the stop plate and the lip of the primary cup just clear of the compensating port, excess fluid which entered through the bleeder holes, or was created by expansion due to increased temperature, now returns to reservoir through the uncovered compensating port. See Figure 9-9, View D.

When pressure in wheel cylinders and pipes becomes slightly less than the tension of master cylinder spring, the check valve returns to its seat on head nut to hold 8 to 16 pounds per square inch of "static" pressure in the pipes and cylinders.

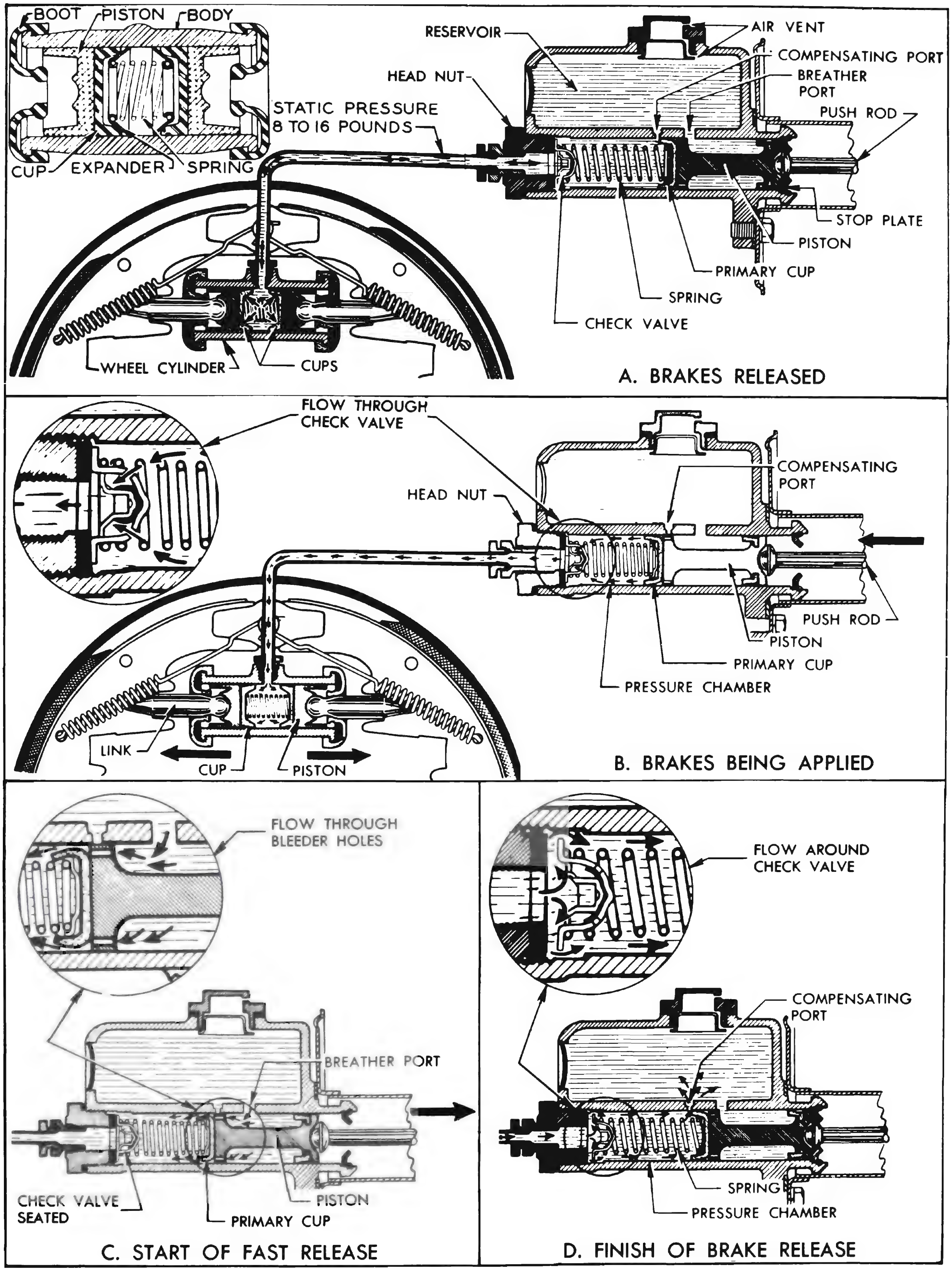


Figure 9-9—Operation of Brake Hydraulic System

SECTION 9-B

BRAKE TROUBLE DIAGNOSIS

CONTENTS OF SECTION 9-B

9-4 INSPECTING AND TESTING BRAKES

a. Inspecting Brakes

At reasonably frequent intervals the brakes should be inspected for pedal reserve, which is the clearance between the pedal pad and the toeboard when the brake pedal is firmly depressed while brakes are cold.

For average driving, pedal reserve with cold brakes should be not less than 2" with regular (foot powered) brakes, or 1" with power brakes. For high speed driving the pedal reserve should not be less than 3" with regular brakes or 1-1/2" with power brakes. Heat generated by high speed stops will expand brake drums and increase shoe clearance, thereby permitting pedal pad to go closer to toeboard when brakes are hot.

Brakes should be corrected whenever the action becomes unduly severe, erratic, or uneven. Brake shoe linings should not be permitted to wear down until rivets contact drums because drums will be scored. As car mileage approaches the point where relining may be required it is advisable to remove one or more drums for inspection of lining in order to avoid the possibility of damaging brake drums.

b. Testing Brakes

Overall brake performance cannot be properly tested with the wheels jacked up because this procedure does not test the self-energizing servo action of the brake shoes and the effect of car weight dis tribution on deceleration.

Brakes should be tested on dry, clean reasonably smooth and level roadway. A true test of brake performance cannot be made if roadway is wet or greasy, or is covered with loose dirt so that all tires do not grip road equally. A true test cannot be made if roadway is crowned so as to throw weight of car toward wheels on one side, or is so rough that wheels tend to bounce.

Test brakes at different car speeds with both light and heavy pedal pressure; however, avoid locking the wheels and sliding the tires on roadway. Locked wheels and sliding tires do not indicate brake efficiency since heavily braked but turning wheels will stop the car in less distance than locked wheels. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

c. External Conditions That Affect Brake Performance

In addition to roadway conditions mentioned (subpar b) the following external conditions may affect brake performance and should be corrected before work is done on the brake mechanism.

a. Tires. Tires have unequal contact and grip on road will cause unequal braking. Tires must be equally inflated and nonskid tread pattern of right and left tires must be approximately equal. Right and left tires must have approximately the same diameter.

b. Car Loading. When car has abnormally unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded car requires more braking effort.

c. Front Wheel Bearings. A loose front wheel bearing permits the drum to tilt and have spotty contact with brake shoe linings, causing erratic brake action.

d. Front End Alignment. Misalignment of the front end, particularly in regards to limits on camber and king pin inclination, will cause brake action to appear unequal between sides.

e. Shock Absorbers. Faulty shock absorbers that permit bouncing of car on quick stops may give the erroneous impression that brakes are too severe.

9-5 BRAKE TROUBLE INDICATIONS AND CORRECTIONS

a. Brake Pedal Travel Excessive, or Pedal Goes to Toeboard

(1) Excessive Brake Shoe Clearance. Excessive clearance is in-

dicated if a good brake is obtained after pumping brake pedal several times.

(2) Fluid Reservoir Empty. If fluid reservoir is empty, a good brake cannot be obtained by pumping brake pedal. Fill reservoir (par. 9-6) and check for springy pedal action (subpar. b, below).

(3) Air in Hydraulic System. Air in hydraulic system will cause a springy action of brake pedal. If volume of air is large, the pedal will go to toeboard under normal pressure. See subparagraph b below for causes of air in hydraulic system. Bleed hydraulic system (par. 9-6).

(4) Fluid Leak in Hydraulic System. A leak in the hydraulic system will allow the pedal to go to the toeboard gradually under continued pressure. An external leak is indicated by loss of fluid in fluid reservoir. Check all brake pipe connections and all cylinders for evidence of fluid loss. If no leaks are found, remove master cylinder, disassemble and check for internal leak. Check for scores or other damage to cylinder bore, piston, or primary cup (par. 9-13).

In Power brake cylinder, check for scores or other damage to hydraulic plunger or rubber cup.

(5) Improper Brake Fluid. Improper brake fluid may boil due to high temperature. Flush system and refill with specified brake fluid (par. 9-6).

b. Springy, Spongy Action of Brake Pedal

(1) Air in Hydraulic System. Air will enter the hydraulic system if there is not sufficient reserve fluid in the master cylinder reservoir. A disconnected pipe permits air to enter the system. A clogged vent will permit air to be drawn in past the piston secondary cup on the return stroke. A leaking check valve causes loss of static pressure in the system, thus permitting air to be drawn in past wheel cylinder cups.

Clean out clogged vent or replace leaking check valve as required. Fill reservoir and bleed hydraulic system (par. 9-6).

(2) Brake Drum Out of Round. Usually indicated by an unstable action of brake pedal. Check brake drums and true up if necessary (par. 9-11).

c. Brakes Severe on Light Pedal Pressure

(1) Loose Front Wheel Bearings. Check for play in bearings with wheels jacked up and adjust if necessary (par. 7-10).

(2) Loose Brake Backing Plate. Tighten all backing plate bolts.

(3) Brake Shoes Not Properly Adjusted.

(4) Excessive Dust in Brake Assemblies. When excessive dust is present, brakes are usually more severe. Thoroughly clean brake shoe linings to remove embedded dirt (par. 9-10).

(5) Faulty Brake Shoe Linings or Drums. Charred linings or scored drums cause grabbing action. A small amount of grease or brake fluid on linings may cause grabbing action. Replace linings and true up or replace scored drums (par. 9-11).

(6) Brake Shoe Linings Reversed. The primary lining is shorter than secondary lining and of different composition. Install brake shoes in proper positions. (par. 9-10).

d. Excessive Pedal Pressure Required

(1) Foreign Substances on Brake Linings. Check for grease, brake fluid, or other foreign substances on linings. Replace grease or fluid soaked linings (par. 9-10). Sand off other foreign substances.

(2) Improper Brake Lining. Very hard brake lining may have poor braking effect. Install standard Buick lining (par. 9-10).

(3) Improper Brake Fluid. Fluid containing substances injurious to rubber will cause swelling of rubber cups in master and wheel cylinders. Replace rubber cups, flush system and refill with specified brake fluid (par. 9-6, 9-12, 9-13).

e. Hard or Sticky Initial Pedal Pressure on Power Brakes

Above conditions may be accompanied by failure of pedal to return to release position when foot pressure is removed.

(1) Binding Pedal Linkage. Remove and lubricate pedal linkage pivot pins with Lubriplate.

(2) Swollen Hydraulic Cups. Replace all rubber parts and completely flush system to remove all traces of mineral oil.

f. Power Brake Cylinder Does Not Boost

(1) Test for power cylinder operation as follows: With engine stopped, depress brake pedal several times to eliminate all vacuum from the system. Apply the brakes and while holding foot pressure on brake pedal, start the engine. If power cylinder is operating, the pedal will move slightly forward when vacuum power is added to the pedal pressure.

(2) If above test shows that power cylinder is not operating, check the following items.

(a) Vacuum Check Valve Stuck Closed. Remove check valve and free up or replace it.

(b) Vacuum Hose Broken or Obstructed. Replace damaged or obstructed hose and make certain connections are tight.

(c) Blocked Air Inlet. Check condition of air cleaner. Clean or replace parts as required.

(d) Air Valve Sticking in Power Piston. Remove and disassemble power cylinder for inspection (par. 9-16).

(3) If above test shows that power cylinder is operating but not giving normal brake action, check the following items.

(a) Insufficient Brake Fluid in System. Fill reservoir, bleed all lines and check for leaks (par. 9-6).

(b) Brake Lining Condition. Check for glazed, dirty, or oily brake linings. Clean or replace.

g. Brakes Drag at One Wheel

(1) Loose Front Wheel Bearings. Check for play in bearings with wheel jacked up and adjust if necessary (Group 7).

(2) Insufficient Clearance at Brake Shoes.

(3) Weak or Broken Brake Shoe Spring. Replace spring and check brake shoe adjustment (par. 9-10).

(4) Wheel Cylinder Piston Stuck or Cups Distorted. May be caused by dirt in hydraulic fluid, improper fluid, or previous use of a cleaning fluid which is detrimental to rubber parts. Overhaul wheel cylinder and replace any defective parts (par. 9-12). It is also advisable to flush hydraulic system to prevent repetition of trouble (par. 9-6).

(5) Obstruction in Brake Pipes or Hoses. Obstruction may be caused by foreign material, damaged pipe, kinked or deteriorated brake hose. Flush hydraulic system (par. 9-6) or replace damaged or defective part as required.

h. Brakes Drag at All Wheels

(1) Insufficient Clearance at Brake Shoes.

(2) Master Cylinder Piston Compensating Holes Closed. If the compensating holes are plugged by foreign material, or are covered by the piston primary cup when brake pedal is in released position, high pressure will be maintained in hydraulic system and brake shoes will be held in contact with drums. This condition is indicated by lack of normal pedal travel and a very solid feel when pedal is depressed.

Make certain that pedal is free on pivot and at push rod connection.

If freeing up brake pedal does not correct the trouble, remove master cylinder for disassembly and thorough cleaning (par. 9-13).

CAUTION: Never insert a test wire through compensating holes as this may leave a burr, which will cut a groove in primary cup.

(3) Wheel Cylinder Piston Cups Distorted. If the rubber parts in master cylinder are found to be swollen and distorted (Step 2, above), it indicates the presence in hydraulic system of a mineral base oil such as kerosene, gasoline, or engine oil. Such substances will cause all rubber parts to swell and distort; therefore it is necessary to thoroughly flush the hydraulic system (par. 9-6) and replace all rubber parts.

i. Power Brakes Do Not Release Properly

Refer to subparagraph h above for causes of brake drag due to conditions other than the power brake cylinder and its control linkage.

(1) Binding Push Rod. See subparagraph e, item (1).

(2) Swollen Hydraulic Cups. See subparagraph e item (2).

(3) Plugged Compensating Ports. Remove and disassemble power cylinder, clean thoroughly (par. 9-17), also flush brake hydraulic system to remove all dirt.

(4) Power Unit Internal Friction. Remove, disassemble and inspect power cylinder, looking particularly for weak or broken springs and for dry rubber cups and "O" ring seals. Reassemble as specified (par. 9-16).

j. Car Pull to One Side

(1) Tires Unequal. Tires unequally inflated, or having unequal wear of treads or different non-skid tread designs may cause car to pull to one side when brakes are applied. Inflate all tires to specified pressure (par. 1-1). Rearrange tires if necessary so that tread non-skid characteristics are more nearly equal on both sides of car.

(2) Brake Shoes Improperly Set. Although hydraulic brakes are self-equalizing so far as applying pressure at each brake shoe is concerned, the brake shoes will not hold equally if not centered in drums, or if the wear pattern is not uniform on all four shoes.

(3) Loose Front Wheel Bearings. Check for play in bearings with wheels jacked up and adjust if necessary (Group 7).

(4) Out-of-Round or Scored Brake Drums. True up or replace as required (par. 9-11).

(5) Brake Linings Not Matched, or Improperly Placed. Brake linings must be of same composition on left and right sides of car, otherwise unequal braking action will result. If primary and secondary linings are interchanged at any wheel, unequal braking will be obtained. Replace or change linings as required (par. 9-10).

(6) Foreign Substances on Some Brake Linings. Any foreign substance on linings will affect braking action. Thoroughly clean any linings having water, sand, paint,

imbedded particles of metal, etc., on surface. Sand or brush the affected surface—do not use any liquid cleaning agent. Linings having oil, grease, or hydraulic fluid on linings cannot be cleaned satisfactorily and must be replaced (par. 9-10).

(7) Loose Brake Backing Plate. Tighten all backing plates.

(8) Unequal Camber. If car has a tendency to lead to one side when driven on a level road it will also pull to one side when brakes are applied. Adjust camber to specified limits (Group 7).

k. Brakes Squeak

(1) Brake Drum Condition. Carefully inspect brake drums for out-of-round, scoring or cracks. Rebore any drum if out-of-round or scored (par. 9-11). Replace any drum which is cracked or has hard spots in braking surface.

(2) Foreign Material Imbedded in Lining. Metallic particles or grit imbedded in brake lining will cause squeaking. Sand the surfaces of linings and remove all particles of metal. In some cases it may be necessary to dress the lining surfaces with a portable resurfacing machine in order to properly clean the surfaces and insure good contact with brake drums.

(3) Linings Loose on Brake Shoes. Replace any rivets that are loose. Lining must be tightly held against brake shoe flange, particularly at the ends (par. 9-10).

(4) Bent Brake Backing Plate. True up or replace backing plate.

(5) Improper Brake Shoe Lining. Install standard Buick Lining or equivalent (par. 9-10).

(6) Shoes Scraping on Backing Plate. Squeaking or "crunch" will be produced if contact surfaces are dry, rusty, or rough. The noise is more pronounced if brake shoes have considerable movement due to large clearance between shoes and drums. Clean, smooth up, and lubricate contact surfaces and reduce shoe movement by adjusting to safe minimum clearance (par. 9-10).

l. Brakes Fade (Fail to Hold)

The condition known as "fade" is caused by loss of friction between brake lining and drums as a result of abnormally high lining temperatures. Excessive heat cooks out the most volatile ingredients of the bonding material in lining and this acts as a lubricant.

Excessive lining temperatures will be produced by partial or spotty contact of linings with brake drums, due to improper adjustment. Excessive lining temperature also can be caused by frequent and heavy braking at high speed, driving with parking brakes partially applied, "riding" the brake pedal, or prolonged use of brakes on steep grades without using low range to obtain adequate engine braking.

After a set of brakes have faded a few times it is probable that they will continue to fade even though the shoes have been adjusted to establish full contact of linings with drums. This is because the cooking out of bonding ingredients has destroyed the frictional properties of the lining surfaces. If the lining thickness is ample and the cooking process has not been prolonged, it may be possible to obtain a correction and some useful life by grinding off about .020" from the lining. Merely sanding off the lining surface will not remove destroyed lining material. If this cannot be done, replacement of lining is the only remedy.

The use of improperly compounded linings will also produce fade. Some replacement linings lose their frictional properties at lower temperatures than the linings selected for Buick brakes. Such linings must be replaced.

When brake drums are rebored too thin they will have excessive expansion due to heat. The result is loss of pedal reserve and braking when drums are hot, and good brakes when drums are cold. This may be erroneously diagnosed as fade, but fade occurs with ample pedal reserve.

SECTION 9-C
BRAKE SERVICE, ADJUSTMENT, REPAIR PROCEDURES

CONTENTS OF SECTION 9-C

9-6 FILLING, BLEEDING, FLUSHING BRAKE HYDRAULIC SYSTEM

a. Filling Brake Master Cylinder

The master cylinder must be kept properly filled to insure adequate reserve and prevent air from entering the hydraulic system. Avoid overfilling.

On all cars (with regular or power brakes), the brake fluid reservoir is on the master cylinder which is located under the hood on the left side.

Thoroughly clean reservoir before removal to avoid getting dirt into reservoir. Add fluid as required to bring level 1/8" below lip of reservoir opening. Use Delco Super No. 11 Hydraulic Brake Fluid or equivalent.

CAUTION: Do not use shock absorber fluid or any other fluid which contains mineral oil. Do not use a container which has been used for mineral oil. Even a trace of mineral oil will cause swelling and distortion of rubber parts in the hydraulic brake system.

Check for clear vent holes in filler cap and make sure diaphragm is in good condition before installing retaining bail.

b. Bleeding Brake Hydraulic System

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system. Since air is compressible and hydraulic fluid is not, the pressure of air in the system is indicated by a springy, spongy feeling on the brake pedal accompanied by poor braking action.

Air will be introduced into the hydraulic system if the brake pedal is operated when the fluid is too low in master cylinder reservoir. Air will also enter the system whenever any part of hydraulic system is disconnected.

It will be necessary to bleed the hydraulic system at all four wheel cylinders if air has been introduced through low fluid level or by disconnecting brake pipe at master cylinder. If brake pipe is disconnected at any wheel cylinder, then that wheel cylinder only need be bled. If pipes are disconnected at any fitting located between master cylinder and wheel cylinders, then all wheel cylinders served by the disconnected pipe must be bled. See Figures 9-5 and 9-6.

c. Sequence of Bleeding Wheel Cylinders

It is advisable to bleed one wheel cylinder at a time to avoid getting fluid level in reservoir dangerously low. The correct sequence of bleeding is left front, right front, left rear, right rear. This sequence expels air from the lines and wheel cylinders nearest to the master cylinder first, and eliminates the possibility that air in a line close to the master cylinder may enter a line farther away after it has been bled.

CAUTION: Do not perform bleeding operation while any brake drum is removed.

d. Bleeding Wheel Cylinder Without Pressure Tank

1. Fill master cylinder (subpar. a, above).

2. Install Wrench J-21472 on bleeder valve. Slip a brake bleeder tube over ball of wheel cylinder bleeder valve. Place lower end of bleeder tube in a clean glass jar. Unscrew bleeder valve 3/4 of a turn. See Figure 9-10.

3. Depress brake pedal a full stroke, then allow pedal to return slowly to released position. Allowing pedal to return quickly may draw air into system. Continue operating pedal in this manner until fluid flows from bleeder tube into glass jar in a solid stream that is free of air bubbles,

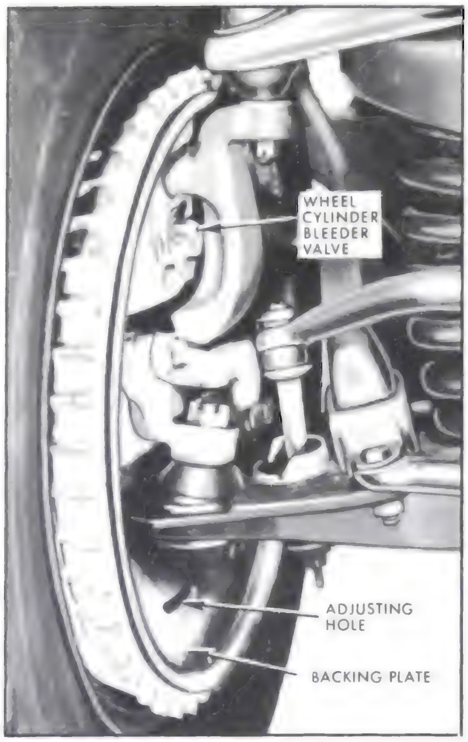


Figure 9-10—Right Wheel and Brake Assembly

then close the bleeder valve securely and remove bleeder tube.

4. Frequently check master cylinder to make sure that it contains fluid. Allowing reservoir to be emptied will cause air to be drawn into hydraulic system.

5. When bleeding operation is completed at all wheel cylinders where needed, make sure that fluid level is 1/8" below lip of master cylinder filler opening; then install rubber diaphragm, cover, and retaining bail.

6. Discard the brake fluid deposited in glass jar during bleeding operation. It is poor economy to attempt to clean fluid that has once been used.

e. Bleeding Wheel Cylinder with Pressure Tank

IMPORTANT: When using a pressure tank, air bubbles may form in the tank and enter the brake hydraulic system. To avoid this, observe the following points when handling a pressure tank: (1) Do not shake or agitate the pressure tank after air pressure has been added or is being added. (2) Allow pressure tank to stand in one position as much as possible, and bring air hose over to tank when adding head of air. (3) Make certain the valves on the pressure tank lines are not defective allowing air to be sucked in when fluid passes through the lines. (4) Pressure tank should be kept at least 1/3 full of fluid to avoid air bubbles forming. (5) If pressure tank is full of air bubbles, release air pressure and bubbles will increase in size, be forced to top of fluid, and escape.

1. Thoroughly clean master cylinder filler cap and surrounding area; then remove cap and diaphragm.

2. Make sure that pressure tank is at least 1/3 full of specified brake fluid, and that hose and master cylinder reservoir are filled with fluid. Attach hose to master cylinder filler opening.

3. Install Wrench J-21472 on bleeder valve. Slip a brake bleeder tube over ball of wheel cylinder bleeder valve. Place lower end of bleeder tube in a clean glass jar. Unscrew bleeder valve 3/4 of a turn. See Figure 9-10.

4. Open pressure tank hose valve to apply fluid to master cylinder under pressure that does not exceed 35 pounds. It is not necessary to pump the brake pedal when using pressure tank.

5. When fluid flows from bleeder tube into glass jar in a solid stream that is free of air bubbles, that particular cylinder and line are bled; tighten bleeder valve securely and remove bleeder tube.

6. When bleeding operation is completed at all wheel cylinders where needed, make sure that fluid level is 1/8" below top of master cylinder filler opening. Then install rubber diaphragm, filler cap, and bail.

f. Flushing Brake Hydraulic System

It is recommended that the entire hydraulic system be thoroughly flushed whenever new parts are installed in the hydraulic system, or new shoes or linings are installed. Flushing is also recommended if there is any doubt as to the grade of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil.

Flushing is performed at each wheel cylinder in turn, and in the same manner as the bleeding operation except that bleeder valve is opened 1-1/2 turns and the fluid is forced through the pipes and wheel cylinder until it emerges clear in color. Approximately one quart of fluid is required to flush the hydraulic system thoroughly.

When flushing is completed at all wheel cylinders, make certain that master cylinder reservoir is filled to proper level.

9-7 BRAKE ADJUSTMENT

a. Preliminary Checks

1. Depress brake pedal firmly. If pedal travels to within 2 inches of toeboard and has a hard feel, brake shoes require adjustment or relining. However, if pedal has a spongy feel, brake system needs bleeding.

2. Remove one front wheel with hub and drum assembly. Inspect brake lining. If lining is worn nearly to rivets, reline brakes (par. 9-10).

3. Check fluid level in master cylinder reservoir and add fluid if necessary (par. 9-6).

4. Fully release parking brake lever and place transmission in neutral.

5. Pull on both ends of rear brake cable a number of times to make sure that cables operate rear brake shoes freely and do not bind in conduits. Check for free movement of cable in brake cable equalizer and check idler lever return spring for tension. Replace a weak or broken spring.

b. Brake Pedal Height and Stop Light Switch Adjustment

NOTE: Brake pedal height cannot be adjusted in either manual or power brake cars.

In both manual and power brake cylinders, non-adjustable push rods connect directly to the brake pedals. Therefore, brake pedal height depends entirely on a stop in the master cylinder, which is also non-adjustable. No external brake pedal return spring is used, so pedal return depends entirely on a spring within the cylinder.

Make certain that the brake pedal returns completely when released slowly. If the pedal does not return freely, check all pivot points for binding or lack of lubrication. With pedal in fully released position, the stop light switch plunger should be fully depressed against an operating plate on the pedal shank. Adjust switch by turning in or out as necessary. See Figures 9-15 and 16.

c. Initial Adjustment at Wheels

1. Remove adjusting hole cover from brake backing plate. Install J-21281 through adjusting hole to move actuator off adjusting screw. Use J-6166 to turn brake adjusting screw, expand brake shoes at each wheel until the wheel can just be turned by hand. Moving end of tool in hand downward expands the shoes. See Figure 9-11. The drag should be equal at all wheels.

2. Back off brake adjusting screw at each wheel 30 notches. If shoes still drag lightly on drum, back off adjusting screw one or two additional notches. NOTE: Brakes should be free of drag when screw has been backed off approximately 6 notches. Heavy drag at this point indicates tight parking brake cables.

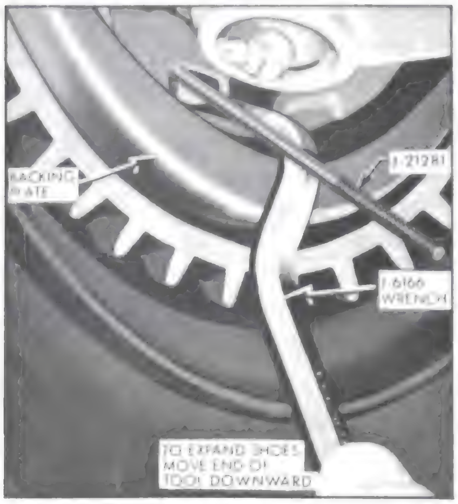


Figure 9-11—Expanding Brake Shoes

3. Install adjusting hole cover in backing plate when adjustment is completed.

4. Check parking brake by depressing parking brake pedal. If pedal depresses more than 8 clicks, cable adjustment is too loose. Release parking brake and check both rear wheels to make sure they turn freely in either direction. If wheels are not free, cable adjustment is too tight or cables may be seized due to rust. Adjust cables as necessary. (par. 9-8).

5. Remove jacks and road test car for service and parking brake performance (par. 9-4).

9-8 PARKING BRAKE ADJUSTMENT—CABLE LUBRICATION

a. Adjustment

Adjustment of the parking brake is necessary whenever the rear brake cables have been disconnected or when the cables have stretched due to extended use. Also to insure proper functioning of the parking brake, the idler lever must have approximately 3/8" clearance in slot in frame as shown in Figures 9-3 and 9-4 when parking lever assembly is fully released. Need for a parking brake adjustment is indicated if the service brake operates with a good pedal reserve, but the parking brake ratchets more than 8 clicks when depressed.

1. Make a brake adjustment as described in paragraph 9-7 (subpar. c).

2. Check for correct position of idler lever in slot in frame with parking brake fully released. See Figure 9-3 and 9-4. If necessary, adjust front cable clevis.

3. Depress parking brake pedal exactly 2 ratchet clicks.

4. Tighten rear cable adjusting nut until rear wheels can just be turned forward using both hands (heavy two-hand drag).

5. Release parking brake lever and check both rear wheels to make sure they turn freely in either direction.

b. Cable Lubrication

Lubrication of parking cables is not included in Lubricare Instructions (par. 1-1) since these cables are usually lubricated during a major brake adjustment. Vehicles habitually operated under conditions where mud and water are frequently encountered may require more frequent lubrication to insure free action and avoid excessive wear of cables.

1. Disconnect rear brake cables at equalizer and pull cables out of frame tunnel and guides. See Figures 9-3 and 9-4.

2. Disconnect rear brake cable conduits from rear brake backing plates and from clips on lower control arms and frame.

3. Slide each conduit away from backing plate as far as possible and coat the cable sparingly with Delco Brake Lubricant, or equivalent. Also lubricate cable where

it passes through the sheave and make sure cable slides freely in sheave.

4. Slide conduit to within 2" of normal position, then clean surplus lubricant from cable at backing plate to avoid forcing it into brake assembly where it will get on brake linings.

5. Connect conduits to clips. Lubricate areas marked with L on Figures 9-3 and 9-4. Insert cables through guides and frame tunnel and attach to equalizer.

6. Adjust parking brake (subpar. a).

9-9 REPLACING BRAKE PIPES

Since brake pipe assemblies (except master cylinder to distributor pipe) are not available from Buick Parts Warehouses, it is therefore necessary to order service bulk tubing and fittings to make up any pipe assembly which is needed. All brake pipes must be made of tin or copper coated wrapped steel tubing with the ends double lap flared. CAUTION: Never use copper tubing because copper is subject to fatigue cracking which would result in brake failure.

To make up a brake pipe assembly, proceed as follows:

a. Procure the recommended tubing and fittings of the correct size. (Outside diameter of tubing is used to specify size.)

b. Cut tubing to length. The correct length may be determined either by measuring the old pipe using a cord, or the length may be found in Group 4.685 of the Buick Chassis Parts Book.

c. Double lap flare tubing ends using a suitable flaring tool such as J-8051. Follow the instructions included in the tool set. CAUTION: Make sure fittings are installed before starting second flare.

d. Bend pipe assembly to match old pipe.

9-10 REPLACE OR RELINE BRAKE SHOES—REPAIR BRAKE LININGS

The most satisfactory method of replacing brake lining is to install new shoe and lining assemblies. This insures brake shoes that are not distorted through use, and linings properly riveted to shoes and ground to correct radius by accurate factory machinery.

Each brake shoe and lining set listed under Group 5.017 is packed in a carton containing two primary and two secondary shoe and lining assemblies, enough for two wheels. Sets are available in standard size and also in .030" oversize for use where brake drums have been rebored.

Brake shoe lining sets are listed under Group 5.018 if the old brake shoes are to be relined. Each lining set is packed in a carton containing two primary and two secondary linings, enough for two wheels. Linings are shaped, drilled, and ground to correct thickness and radius, and are packaged with enough rivets for installation on shoes. Lining sets are available in standard and .030" oversizes.

Brake lining or shoe assemblies must be selected according to brake drum size as follows:

1. Drum inside diameter under 12.050" -- use standard lining.

2. Drum inside diameter over 12.050" -- use .030" oversize lining.

If the brake drum size is over 12.080", the drum should be replaced.

To assure an adequate supply, several optional types of brake shoe lining have been approved for production and service. Since

Figure 9-12—Measuring Brake Drum Size

the optional types of lining have slightly different characteristics it is important to use primary and secondary shoe linings that are matched according to engineering specifications, and to use the same type of linings on right and left sides at front or rear end of car. It is not possible to identify the various types of lining by inspection; however, each carton listed under Groups 5.017 and 5.018 contains correctly matched primary and secondary linings. The parts from several different cartons should not be used at one end of a car; however the linings at front and rear brakes do not have to be of the same type.

Brake linings are made of asbestos for its heat resisting qualities and compounds of bonding material for strength. Some bonding materials are used for their lubricating qualities to guard them against drum scoring while others are used to control the friction producing property of the lining, called "coefficient of friction." Good molded linings also have

Figure 9-13—Rear Wheel Brake Assembly

imbedded particles of material used to control friction and wear. When linings are ground, some of the surface particles may be pulled out, giving a pitted appearance. These pits do not affect lining efficiency.

The heat generated by friction will produce different effects in different compounds of bonding material. Some compounds increase friction with increased temperature, which might cause grabbing or locking. Other compounds lose friction with increased temperature, which might cause materially lowered braking power. Brake lining compounds must be carefully selected to produce the braking friction required at the temperatures normally attained in each vehicle application.

Since the many factors which govern the selection of brake lining vary widely in different vehicle designs, it is impossible to compound one lining which will work satisfactorily on all cars. GM engineered brake lining has been selected after exhaustive tests on all types of lining and with complete consideration of all the requirements existent in the various Buick models.

a. Removal and Inspection

NOTE: When paragraph references in parentheses () have an asterisk (*) the operation referred to is additional work not covered by the standard replacement operation.

1. Jack up car in a safe manner, remove wheel, and brake drum (rear) or drum and hub assembly (front). NOTE: Stops located on the backing plates will prevent pistons from leaving the wheel cylinders; however, brake pedal must not be operated while a brake drum is removed.

NOTE: It may be necessary to back off the brake shoe adjustment before the brake drums can be removed. To back off shoe adjustment, rotate shoe adjusting screw upward. See Figure 9-11.

2. Unhook the primary and secondary shoe return springs using large pliers.

3. Remove shoe hold down springs.

4. Lift up on actuator, unhook actuating link from anchor pin, then remove.

5. Spread shoes to clear wheel cylinder connecting links, remove parking brake strut and spring (rear only), disconnect cable from parking brake lever, remove shoes from the backing plate.

6. Separate the brake shoes by removing adjusting screw and lock spring. Remove parking brake lever from secondary brake shoe (rear only). See Figure 9-13.

7. Clean all dirt out of brake drum, using care to avoid getting dirt into front wheel bearings. Inspect drums and replace or recondition if required (*par. 9-12). If front drum and hub is removed, inspect wheel bearings and oil seal and replace faulty parts (*Group 7).

8. Blow all dirt from brake assemblies and inspect for any unusual condition.

9. Carefully pull lower edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Fluid at this point indicates leakage past piston cup, requiring overhaul of wheel cylinder (*par. 9-13).

10. Inspect all brake pipe and hose connections for evidence of fluid leakage. Tighten any leaking connection, then apply heavy pressure to brake pedal and recheck connections.

11. If working at rear wheels, inspect backing plate for oil leak past wheel bearing oil seals. Correct any leak by installation of new seals (*par. 6-6).

12. Check all backing plate attaching bolts to make sure they are tight. Clean all rust and dirt from shoe contact surfaces on plate, using fine emery cloth.

b. Relining Brake Shoes

If old brake shoes are to be relined, inspect shoes for distortion and for looseness between the rim and web; these are causes for discarding any shoe. If shoes are serviceable, be governed by the following points in installing new linings:

1. Remove old linings by drilling out rivets. Punching rivets out will distort shoe rim. Thoroughly clean surface of shoe rim and file off any burrs or high spots.

2. Use Buick brake lining or equivalent. Rivets are included in lining package which are of correct size. The rivets must fit the holes and the solid body of rivet should extend through the shoe rim, but no farther.

3. Keep hands clean while handling brake lining. Do not permit oil or grease to come in contact with lining.

4. Start the riveting at center of shoe and lining and work toward

the ends. Use a roll set for riveting; a star set might split the tubular end and then the rivet would not fill the hole. The primary lining is shorter than secondary lining, therefore the rivet holes at each end of shoe rim are not used.

5. After riveting is completed, lining must seat snugly against shoe with no more than .005 separation midway between rivets. Check with a .004 (permissible) and a .006 (no go) feeler gauge.

c. Installation and Adjustment

1. On rear brakes only, lubricate fulcrum end of parking brake lever with Delco Brake Lubricant, or equivalent, then attach lever to secondary shoe. Make sure that lever is free moving.

2. Connect brake shoes together with lock spring; then place adjusting screw in position. CAUTION: WHEN INSTALLING ADJUSTING SCREW MAKE SURE RIGHT HAND THREAD ADJUSTING SCREW IS ON LEFT SIDE OF CAR AND LEFT HAND THREAD ADJUSTING SCREW ON RIGHT SIDE OF CAR.

3. Lubricate shoe contact surfaces with a thin coating of Delco Brake Lubricant or equivalent. On rear brakes, sparingly apply same lubricant where brake cable contacts backing plate.

4. Place brake shoes on backing plate, at the same time engaging shoes with wheel cylinder links. The primary shoe (short lining) goes forward. On rear brakes, connect cable to parking brake lever and install strut and spring between lever and primary shoe as shown in Figure 9-13.

5. Install actuator, actuator return spring and actuating link as shown in Figure 9-13.

NOTE: If old brake shoe return springs are nicked, distorted, or of doubtful strength, it is advisable to install new ones.

6. Install shoe hold-down springs.

7. Install the primary and secondary shoe return springs using large pliers being careful not to distort springs.

8. Install brake drums and wheels. Lubricate and adjust front wheel bearings. Remove all adjusting hole covers from backing plates.

9. Install J-21381 through adjusting hole to move actuator off adjusting screw. See Figure 9-11.

10. Turn adjusting screws to provide an equal two-hand drag and back-off 30 notches for proper shoe clearance (par. 9-8).

11. If any hydraulic connections were disturbed, bleed hydraulic system (par. 9-7). If new parts were installed in brake system, flushing of hydraulic system is recommended (par. 9-7).

12. Adjust parking brake as described in paragraph 9-8.

13. Check fluid level in master cylinder and add fluid if necessary.

14. Check brake pedal for proper feel and for proper return.

15. Remove jacks and road test car for proper brake action (par. 9-5).

IMPORTANT: Brakes must not be severely applied immediately after installation of new brake shoes or linings. Severe application may permanently injure new linings and may score brake drums. When linings are new they must be given moderate use for several days until nicely burnished.

d. Repairing Brake Linings

This procedure is to be used when brake action is unequal, severe, hard, noisy or otherwise unsatisfactory, but brake linings have had very little wear.

1. Jack up car in a safe manner and remove all wheels.

2. Check fluid in master cylinder and add fluid if necessary.

3. Check brake pedal for proper feel and for proper return.

4. Remove all brake drums. CAUTION: Brake pedal must not be operated while drums are removed.

5. Clean all dirt out of brake drums, using care to avoid getting dirt into front wheel bearings. Inspect drums and replace or recondition if required (par. 9-11).

6. Blow all dirt from brake assemblies, then inspect brake linings for uneven wear, oil soaking, loose rivets, or imbedded foreign particles. If linings are oil soaked, replacement is required.

7. If linings are otherwise serviceable, tighten or replace loose rivets and thoroughly clean all steel or other imbedded particles from surfaces and rivet counterbores of linings.

8. If brake linings at any wheel show a spotty wear pattern indicating uneven contact with brake drum, it is advisable to true up the linings with a light grinding cut, if suitable grinding equipment is available. If brake action was unequal, severe or hard, indicating that brake shoes were not centralized in drums, the grinder may also be used to correct this condition.

Grinding equipment which locates and swings off the wheel spindle or axle shaft may be used to grind shoes concentric with drums, or a bench mounted grinder may be used to grind shoes to the proper radius (.010" less than drum radius). The instructions of equipment manufacturer must be carefully followed.

9. Check all backing plate bolts to make sure they are tight.

10. Lubricate front wheel bearings, if necessary. Install front hub and drum assemblies and adjust wheel bearings.

11. Install brake drums. Remove all adjusting hole covers.

12. Install all wheels, turn adjusting screws to provide an equal two-hand drag and back-off 30 notches (par. 9-7).

13. Remove jacks and road test car for proper brake action.

IMPORTANT: Brakes must not be severely applied immediately after installation of new brake shoes or linings. Severe application may permanently injure new linings and may score brake drums. When linings are new they must be given moderate use for several days until burnished.

9-11 INSPECTING AND RECONDITIONING BRAKE DRUMS

Whenever brake drums are removed they should be thoroughly cleaned and inspected for cracks, scores, deep grooves, and out-of-round. Any of these conditions must be corrected since they can impair the efficiency of brake operation and also can cause premature failure of other parts.

a. Cracked, Scored, or Grooved Drum

A cracked drum is unsafe for further service and must be replaced. Welding a cracked drum is not recommended.

Smooth up any slight scores by polishing with fine emery cloth. Heavy or extensive scoring will cause excessive brake lining wear and it will probably be necessary to rebore in order to true up the braking surface.

If the brake linings are little worn and drum is grooved, the drum should be rebored just enough to remove grooves, and the ridges in the lining should be lightly removed with a lining grinder.

If brake linings are more than half worn, but do not need replacement, the drum should be polished with fine emery cloth but should not be rebored. At this stage, eliminating the grooves in drum and smoothing the ridges on lining would necessitate removal of too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained.

If brake linings are to be replaced, a grooved drum should be rebored for use with oversize linings (subpar. c, below). A grooved drum, if used with new lining, will not only wear the lining but will make it difficult, if not impossible, to obtain efficient brake performance.

b. Out-of-round or Tapered Drum

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and very irregular tire tread wear.

A drum that is more than .010" out-of-round on the diameter is unfit for service and should be rebored (subpar. c, below). A drum that has more than .005" taper should be rebored. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper, and wear, take measurements at the open and closed edges of machined surface and at right angles to each other. Standard drums are machined to an inside diameter of 11.997" to 12.007", with runout of braking surface held within .005" total indicator reading.

c. Reboring Brake Drum

If a drum is to be rebored, enough metal should be removed to obtain a true, smooth braking surface. If a drum does not clean-up when rebored to a diameter of 12.080", it must be replaced. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

A newly bored drum should always have center contact with the shoes on initial break-in, thus insuring greater uniformity in brake performance with less danger of brake pulling. To get this desired position, the shoe radius should always be .010" less than the drum radius (or .020" less on the diameter). This fit may be accomplished by either grinding the shoes or boring the drums, whichever is the more practical.

If cleaning up a drum requires boring to a size larger than 12.050", then .030" oversize lining must be used.

Fit between the brake shoes and the drum must always be the same on both sides of the car to get equal braking action.

Brake drums may be refinished either by turning or grinding. Best brake performance is obtained by turning drums with a very fine feed. Ground and polished drums do not wear in as readily as turned drums and are more likely to cause unequal braking when new. To insure maximum lining life, the refinished braking surface must be smooth and free from chatter or tool marks.

Run-out of the refinished surface of brake drum must not exceed .005" total indicator reading. Run-out (sideways wobble) of the open edge of drum must not exceed .030".

d. Brake Drum Balance

During manufacture, brake drums are balanced within 3 inch ounces by fastening weights, as required, near the rim. These weights must not be removed.

After drums are rebored, or if difficulty is experienced in maintaining proper wheel balance, it is recommended that brake drums be checked for balance. Drums out of balance more than 3 inch ounces may be corrected by installation of service balance weights. Brake drums may be checked for balance on most off-the-car wheel balancers.

9-12 BRAKE WHEEL CYLINDER OVERHAUL

1. Remove wheel, drum, and brake shoes. Be careful not to get grease or dirt on brake lining.

2. Disconnect brake pipe or hose from wheel cylinder and cover opening with tape to prevent entrance of dirt. Remove wheel cylinder from backing plate.

3. Remove links, boots, pistons, cups, cup expanders and spring from cylinder. Remove bleeder valve.

4. Discard rubber boots, expander assembly, and piston cups. Thoroughly clean all other parts with hydraulic brake fluid or a good grade of alcohol. CAUTION: Do not use antifreeze alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil.

5. Inspect pistons and cylinder bore for scores, scratches, or corrosion. Light scratches may be polished with crocus cloth. Do not use emery cloth or sandpaper. Slight corrosion may be cleaned with fine steel wool and alcohol. If scratches or corroded spots are too deep to be polished satisfactorily the cylinder should be replaced since honing is not recommended.

6. Dip internal parts in brake fluid and reassemble wheel cylinder. When installing piston cups use care to avoid damaging the edges.

NOTE: Front wheel cylinder pistons and cups are 1-1/8" diameter and rear wheel cylinder parts are 1" diameter.

7. Install wheel cylinder on brake backing plate and connect brake pipe or hose.

8. Install brake shoes, drum, and wheel, then flush and bleed hydraulic system (par. 9-6).

9. Adjust brakes (par. 9-7) then road test car for brake performance (par. 9-4).

9-13 BRAKE MASTER CYLINDER OVERHAUL

a. Removal of Brake Master Cylinder

1. Disconnect brake pipe from master cylinder and tape end of pipe to prevent entrance of dirt.

2. Disconnect brake pedal from master cylinder push rod by removing safety washer and retainer. See Figures 9-7 and 9-8.

3. Remove two nuts holding master cylinder to dash panel and remove cylinder from car. Be careful not to drip brake fluid on exterior paint.

4. Clean outside of master cylinder thoroughly. Remove filler cap and diaphragm, turn cylinder over, and pump push rod by hand to drain all brake fluid. Always discard used fluid.

b. Disassembly of Brake Master Cylinder

1. Remove rubber boot. Remove lock ring, then remove push rod with stop plate. See Figure 9-14.

2. Remove piston with secondary cup, primary cup, spring, check valve, and valve seat washer.

3. Discard boot, lock ring, piston and rubber cups, spring, check valve, and valve seat washer. These parts are furnished in the master cylinder repair kit (Group 4.649).

4. Remove reservoir cover and gasket. Thoroughly clean master cylinder with alcohol. CAUTION: Do not use anti-freeze alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil.

c. Inspection of Brake Master Cylinder

Inspect cylinder bore for scores, scratches, or corrosion. Light scratches in cylinder bore may be polished with crocus cloth. Do not use emery cloth or sandpaper. Slight corrosion may be cleaned with fine steel wool and alcohol.

If scratches or corroded spots are too deep to be polished satisfactorily, the cylinder should be replaced since honing is not recommended and oversize pistons and cups are not furnished for service.

Wheel and master cylinder bores have a hard, highly polished "bearingized" surface produced by diamond boring followed by rolling under very heavy pressure. Honing destroys the bearingized surface, leaving a softer and rougher surface which will cause more rapid wear of pistons and rubber cups. Higher friction produced by the rougher surface will also reduce braking power for a given pressure on brake pedal.

The maximum allowable clearance between piston and cylinder bore is .0055". If this clearance is increased by honing, the heavy pressure of brake fluid may force rubber of the cup into the clearance and cause sticking or early

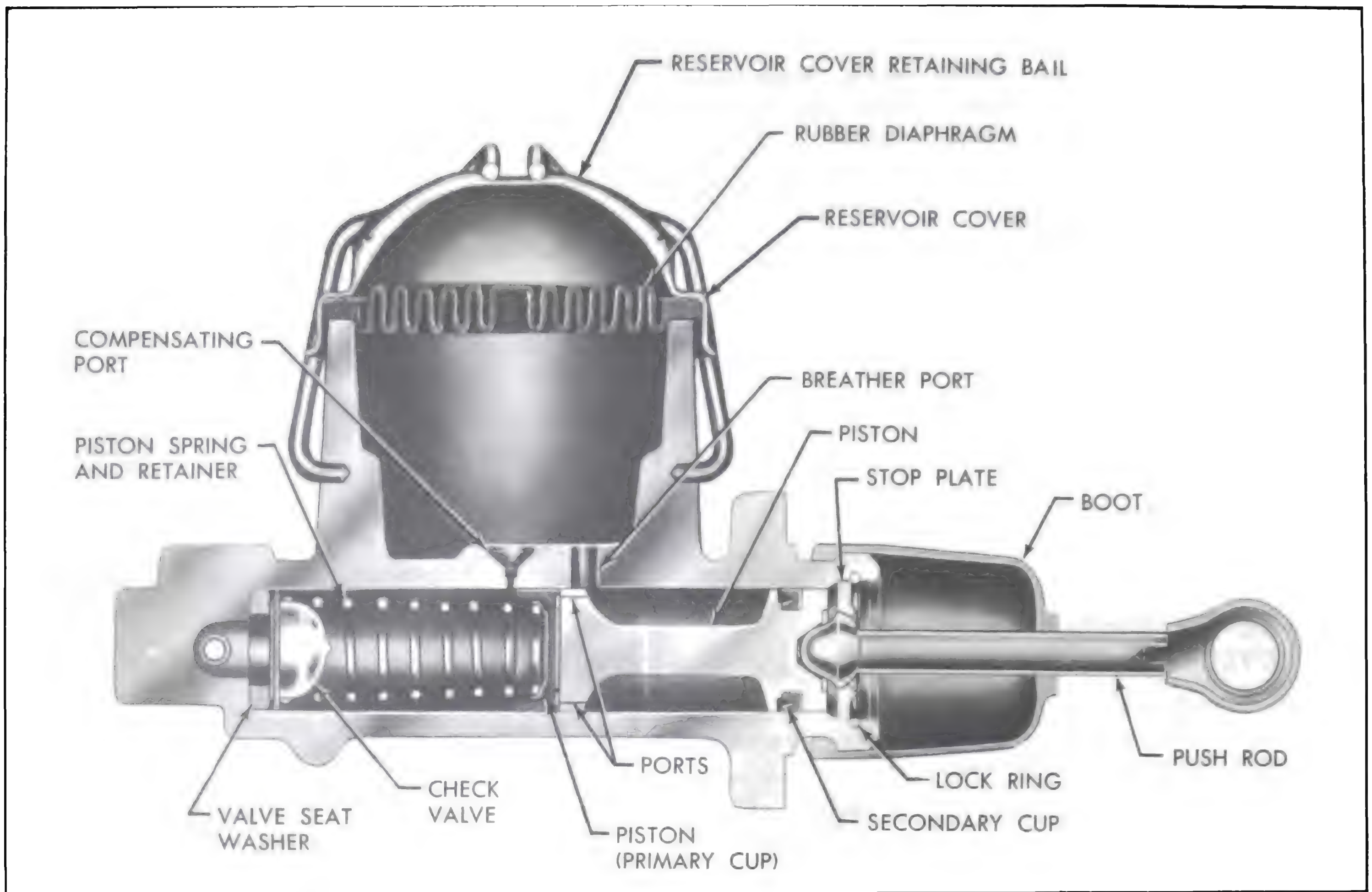


Figure 9-14—Standard Brake Master Cylinder

failure of the cup. If a choice must be made between honing or replacement of the cylinder, it must be remembered that while a new cylinder may be more expensive a honed cylinder may not give satisfactory length of service.

Make certain that compensating port in cylinder is clear; however, do not run a wire through port as this may result in leaving a burr which will cut a groove in primary cup.

d. Assembly of Brake Master Cylinder

1. Dip all internal parts in clean brake fluid just before installation. Also wet master cylinder bore with brake fluid.

2. Install valve seat washer, check valve, spring, primary cup, and piston with secondary cup. Then install push rod and stop plate assembly. Hold push rod in and install lock ring. Check for proper seating of lock ring with a hard pull on push rod.

3. Install rubber boot. Check filler cap holes to make sure they are clear, then install rubber diaphragm, cap and bail.

e. Installation of Brake Master Cylinder

1. Install master cylinder on dash panel. Torque nut to 20-28 ft. lbs.

2. Connect push rod to brake pedal by installing spring washer, shoulder bolt and locknut.

3. Connect brake pipe to master cylinder.

4. Bleed hydraulic system as described in paragraph 9-6. Bleed left front wheel cylinder first and check for proper pedal feel. If system still has air in it, bleed other three wheel cylinders. After bleeding, bring fluid to 1/8" below lip of reservoir opening.

5. Check brake pedal for full return and check stop light switch adjustment as described in paragraph 9-7 (b).

6. Road test car for proper brake performance (par. 9-4).

SECTION 9-D

POWER BRAKES

CONTENTS OF SECTION 9-D

9-14 DESCRIPTION OF POWER BRAKE SYSTEM

a. General Description

The power brake system combines a hydraulic master cylinder with a vacuum suspended power cylinder which utilizes intake-manifold vacuum and atmospheric pressure to provide power-assisted application of brakes. The combined unit takes the place of a master cylinder in a conventional brake system. From the master cylinder unit outward to the wheel units, the power brake system is the same as a conventional brake system.

The power brake requires a mechanical connection to a brake pedal which is suspended from a bracket mounted between the dash panel and the cowl. The push rod from the power unit connects to the brake pedal pin by a special washer and retainer. The pedal pivots on nylon bushings which are lubricated at assembly and do not require periodic lubrication. Because there is no pedal stop, the pedal position when released is determined by a stop built into the power cylinder. There is no linkage adjustment, and therefore no pedal height adjustment. See Figures 9-15 and 9-16.

The power brake unit provides lighter pedal pressures obtained in combination with reduced pedal travel which makes it possible to bring the brake pedal down to the approximate height of the accelerator pedal when at closed throttle position. Therefore, after closing the throttle, the driver can shift his toe from one pedal to the other without lifting his heel from the floor.

In addition to the master cylinder and brake pedal connections, the power unit requires a vacuum connection to the engine intake-manifold (through a vacuum check valve). See Figures 9-15 and 9-16. The check valve permits several power applications of the brakes after the engine has stopped or after vacuum supply has been interrupted some other way. After vacuum reserve has become exhausted, brakes can be applied in the conventional manner, but additional pedal pressure is required.

b. Construction of Power Brake Unit

The unit is composed of two main sections: the vacuum power cylinder, and the hydraulic master cylinder.

The power cylinder is vacuum suspended, meaning that vacuum is present in the chambers on both sides of the power piston when the brake is in the unapplied position. As shown in Figure 9-17, a front and rear housing interlock to form a large chamber in which the power piston and related parts operate. The vacuum chamber at the front of the power piston is partitioned off from the vacuum chamber at the rear by a rubber diaphragm. The inner edge of the diaphragm is held between the two parts of the power piston assembly; the outer edge is clamped between the front and rear housing. When in unapplied position, passages in the power piston allow vacuum to enter the rear chamber from the front. During brake application, vacuum is shut off to the rear chamber, and atmospheric pressure enters through an air filter element. This element is assembled around the pedal push rod and fills the cavity inside the hub of the power piston.

The power piston assembly houses the control valve and reaction mechanism, and the power piston return spring. The control valve is composed of an air valve and floating control valve assembly. The reaction mechanism consists of a hydraulic piston reaction plate and three reaction levers. The push rod, which operates the air valve, projects out of the rear of the power piston through a boot. A vacuum check valve assembly is mounted in the front housing for connection to a vacuum source. See Figure 9-20.

The master cylinder push rod is a steel plunger which extends from the heart of the power cylinder section into the master cylinder section. The master cylinder contains a fluid reservoir which supplies fluid to fill the space between the primary cup and the secondary seals through a

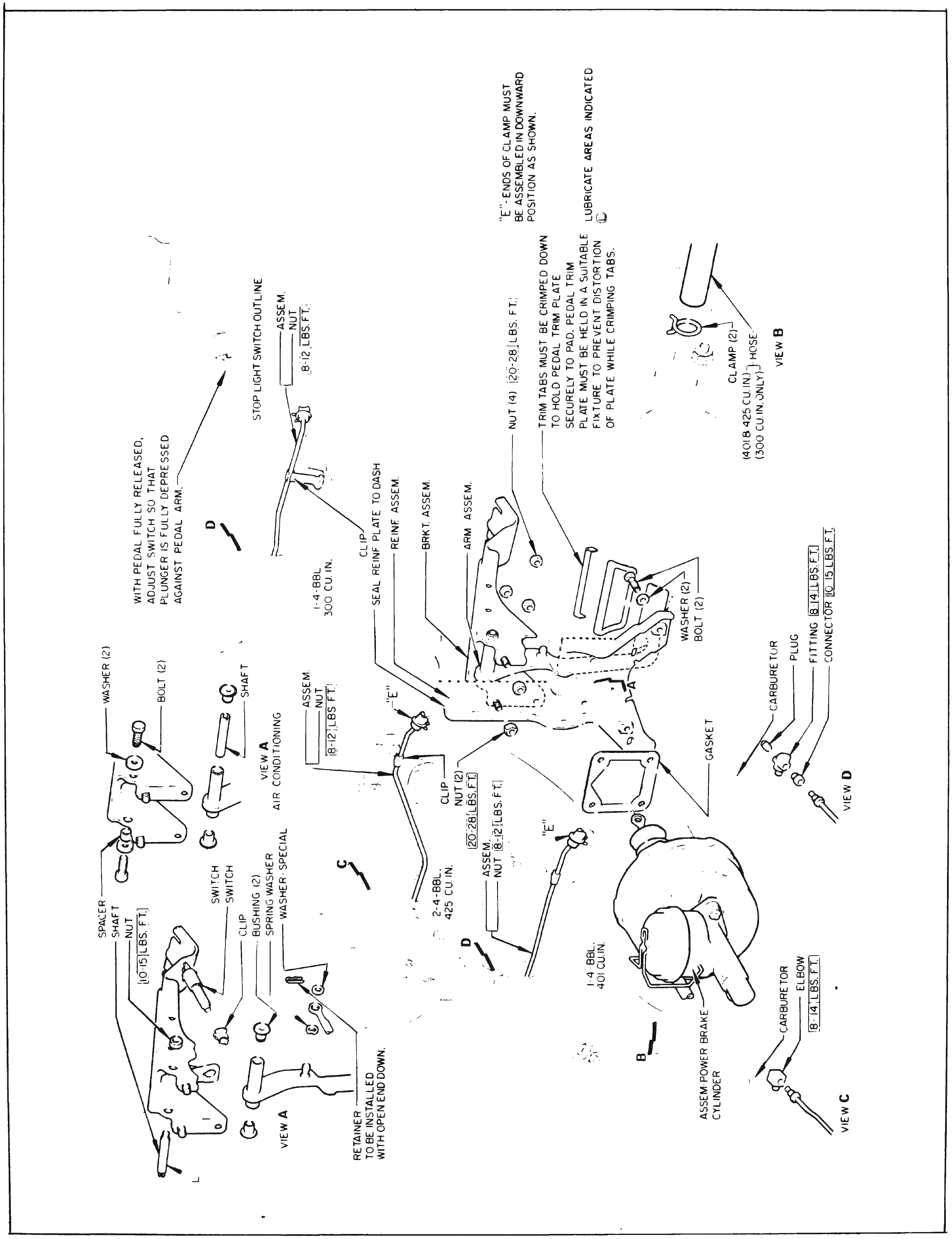


Figure 9-15—Power Brake Installation (4400-4600 & 4800 Series)

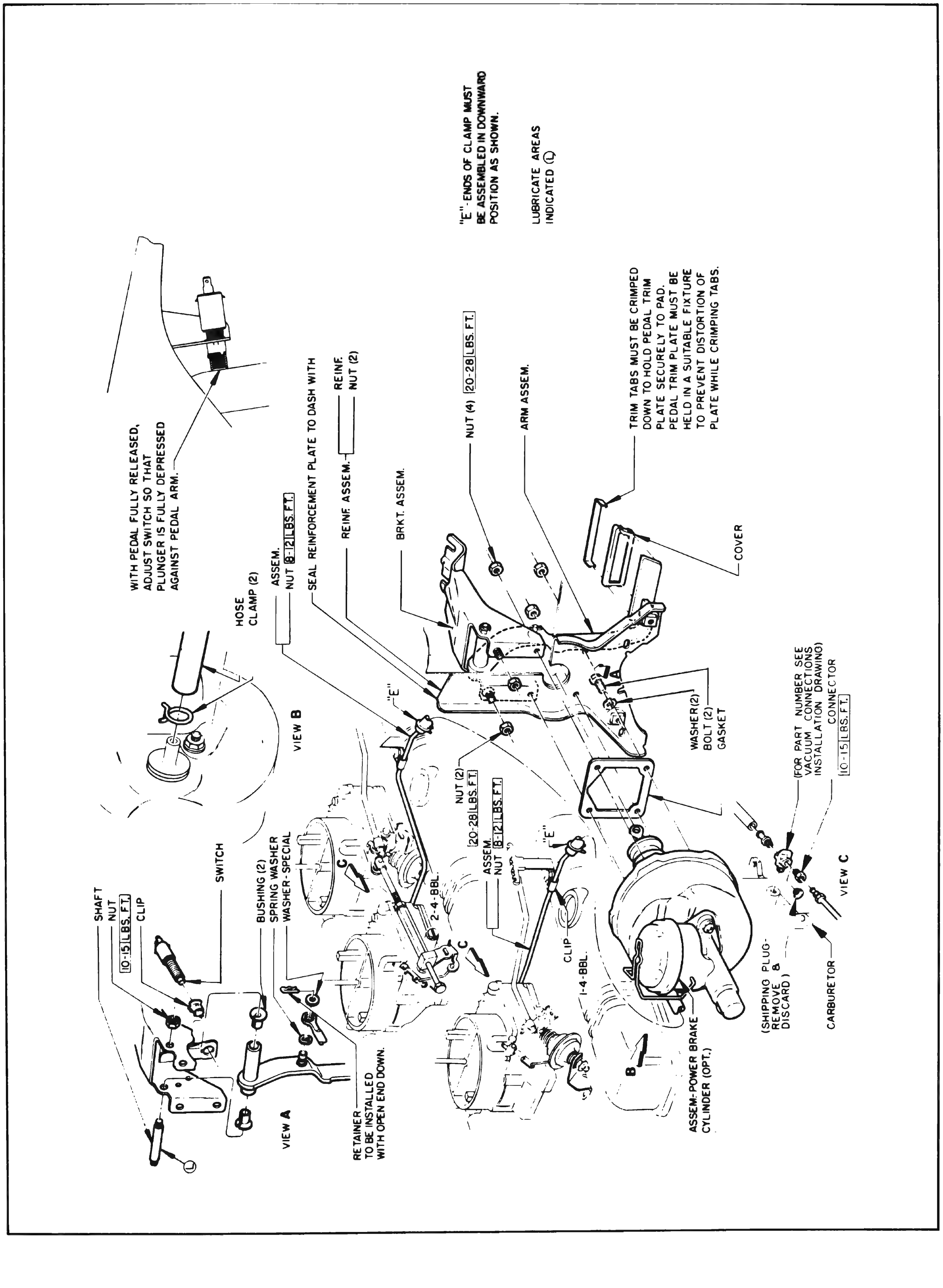


Figure 9-16—Power Brake Installation (4700 Series)

hole in the casting. When the brake pedal is released quickly, the master cylinder piston returns immediately (to the released position). Since fluid from the lines cannot return as quickly as the piston, compensation is provided by a flow of fluid through holes in the piston, past the lip of the primary cup. As fluid from the lines returns, the excess fluid in the master cylinder bore flows into the reservoir through a small compensation port.

Connection is made to the wheel cylinders through brake pipes and a conventional check valve. This check valve and a return spring maintain a static residual pressure in the hydraulic brake system.

c. Operation of Power Brake Unit

Description of power brake cylinder operation will cover (1) Released Position, (2) Applying, (3) Holding, (4) Releasing, (5) Manual Applying.

(1) Released Position

A line from the engine intake-manifold is connected to the vacuum check valve in the front housing of the power brake. This check valve is to prevent loss of vacuum when manifold vacuum falls below that in the power brake system.

At the released position the air valve is seated on the floating control valve. See Figure 9-17. The air under atmospheric pressure, which enters through the filter element in the tube extension of the power piston, is shut off at the air valve. The floating control valve is held away from the valve seat in the power piston insert. The vacuum, which is present at all times in the space to the left of the power piston, is free to evacuate any existing air

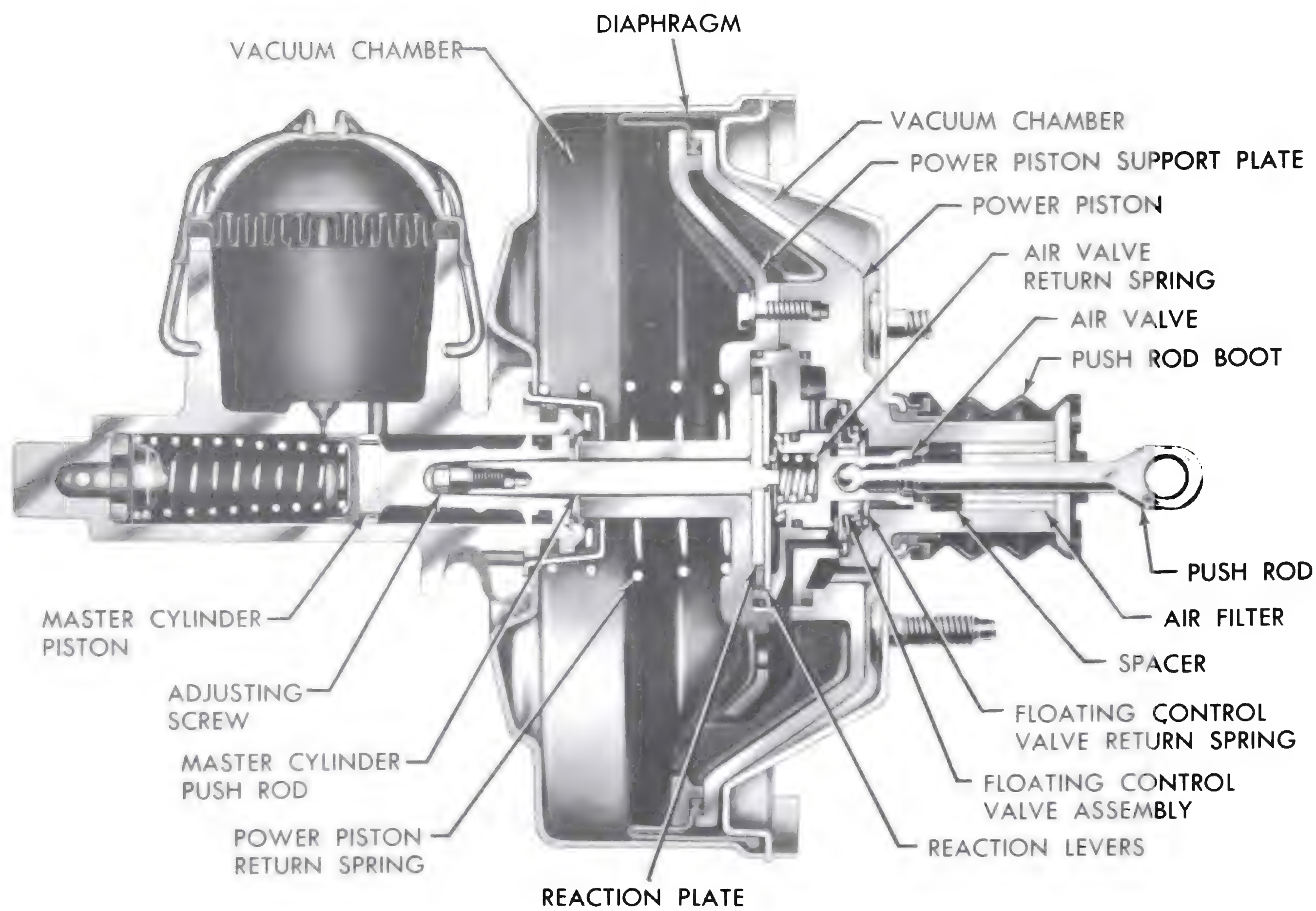


Figure 9-17—Power Brake Unit—Released Position

on the right side of the power piston. This air is drawn through a small passage in the power piston, over the valve seat in the power piston insert, and then through a passage in the power piston insert. From here it travels through a hole in the power piston support plate into the space at the left of the power piston. It is then drawn through the check valve and thence to the vacuum source.

In this position there is vacuum on both sides of the power piston, and the power piston is held against the rear housing by the power piston return spring. At rest the hydraulic reaction plate is held against the support plate. The reaction levers are held against the hydraulic reaction plate by the air valve spring. The air valve is held against its stop in the tube of the power piston by the air valve spring.

The floating control valve assembly is held against the air valve seat by the floating control valve spring. In this position, the by-pass hole in the hydraulic master cylinder is open to the reservoir and fluid can flow freely in either direction between the hydraulic cylinder and the fluid reservoir. A residual pressure is maintained in the brake lines by the check valve and its spring.

(2) Applying Position

As the pedal is depressed, the push rod carries the air valve away from the floating control valve. See Figure 9-18. The floating control valve will follow until it is in contact with the raised seat in the power piston insert. When this occurs, the vacuum is shut off to the right hand side of the power piston, and air under atmospheric pressure rushes through the air filter and travels past the seat of the air valve and through a passage way into the housing on the right of the power piston.

Since there is still vacuum on the left side of the power piston, the

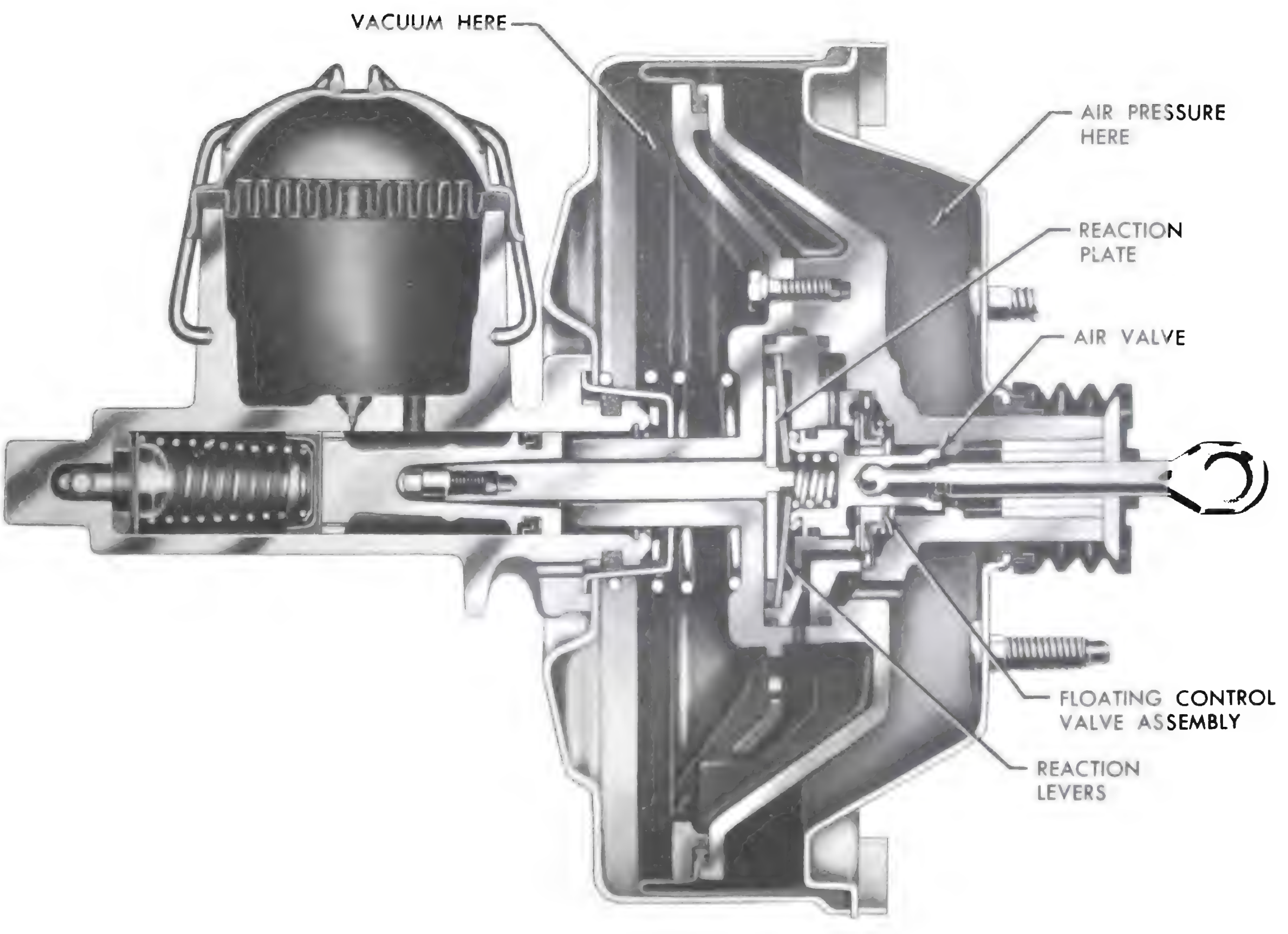


Figure 9-18—Power Brake Unit—Applying

force of the air at atmospheric pressure on the right of the piston will force the power piston to travel to the left.

As the power piston travels to the left, the master cylinder push rod carries the master cylinder piston into the bore of the master cylinder. As the master cylinder piston cup passes the by-pass hole, hydraulic pressure starts to build up in the hydraulic system. As the pressure builds up on the end of the master cylinder piston, the hydraulic reaction plate is moved off its seat on the support plate and presses against the reaction levers. The levers, in turn, swing about their pivots and bear against the end of the air valve-push rod assembly.

In this manner, approximately 30% of the load on the hydraulic master cylinder piston is transferred back through the reaction system to the brake pedal. This gives the operator a feel, which is proportional to the degree of brake application.

(3) Holding Position

When the desired pedal pressure is reached, the power piston moved to the left until the floating control valve, which is still seated on the power piston insert, again seats on the air valve. The power brake will now remain stationary, until either pressure is applied or released at the brake pedal. See Figure 9-19.

(4) Releasing Position

As the pressure at the pedal is released, the air valve spring forces the air valve back to its stops on the power piston. As it returns, the air valve pushes the floating control valve off its seat on the power piston insert.

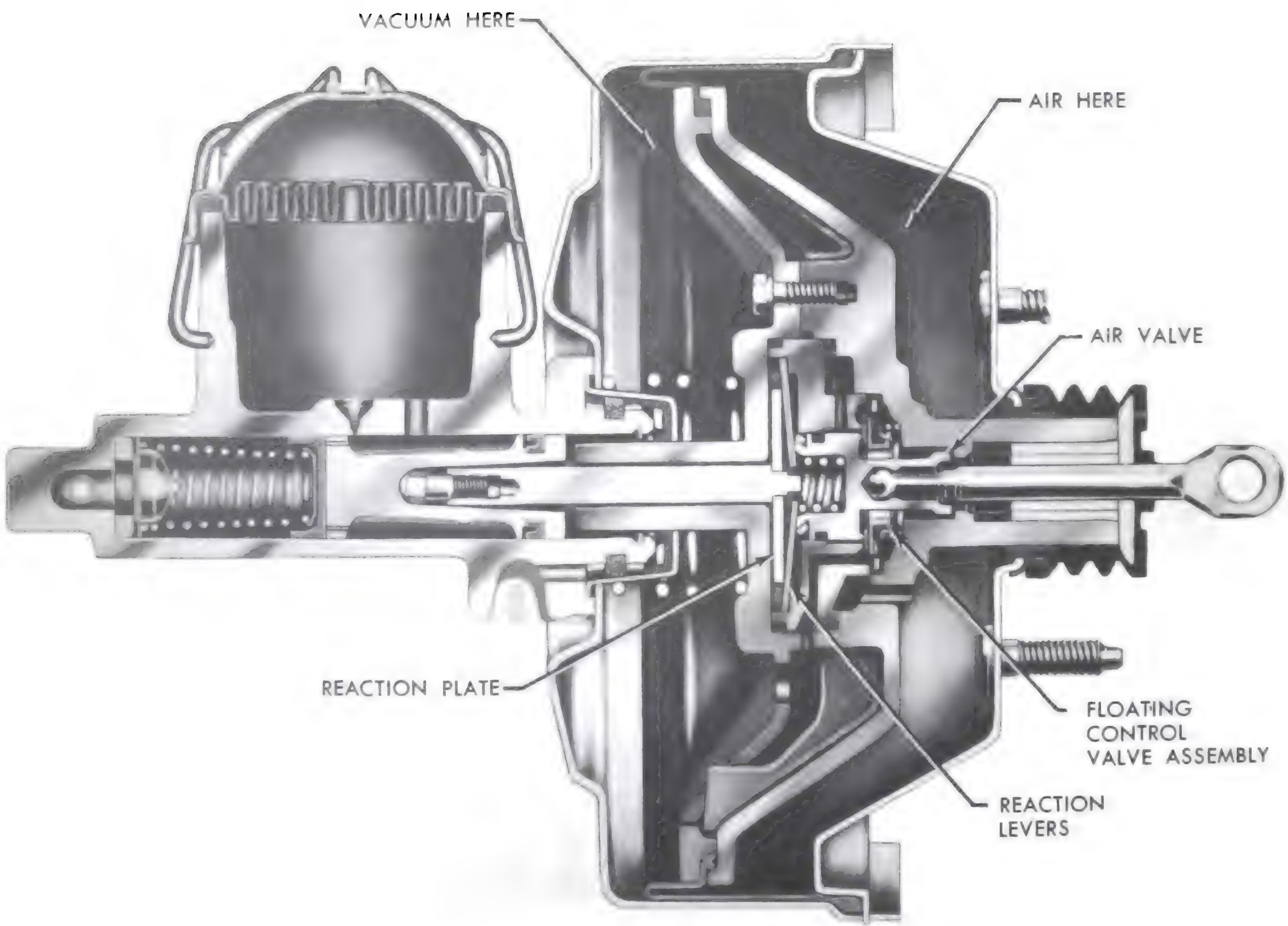


Figure 9-19—Power Brake Unit—Holding

The air valve seating on the floating control valve has shut off the outside air source. When it lifts the floating control valve from its seat on the power piston insert, it opens the space to the right of the power piston to the vacuum source.

Since both sides of the power piston are now under vacuum, the power piston return spring will return the piston to its released position against the rear housing. As the power piston is returned, the hydraulic master cylinder piston moves back, and the fluid from the wheel cylinders flows back into the master cylinder through the check valves.

If the brake pedal is released quickly, the master cylinder piston immediately returns to the released position. If the fluid in the lines cannot return as quickly as the piston, compensation is provided for by the flow of fluid from the space between the primary cup and the secondary seal through the holes in the piston. The excess fluid in the system can flow back to the fluid reservoir through the small by-pass holes in the master cylinder bore after the brake is released.

(5) Manual Application

In case of vacuum source interruption, as the pedal is pushed down the end of the air valve contacts the reaction levers and forces them, in turn, against the hydraulic reaction plate. Since the hydraulic reaction plate is fastened to the master cylinder push rod, it forces the push rod against the master cylinder piston, which builds up the hydraulic line pressure.

The pedal pressure required for a manual application, such as described, is considerably greater than with vacuum assist.

9-15 REMOVAL, INSTALLATION, ADJUSTING, TESTING OF POWER BRAKE UNIT

a. Removal of Power Brake Unit

1. Disconnect brake pipe from hydraulic master cylinder and tape end of pipe to prevent entrance of dirt.

2. Remove retainer and special washer from brake pedal pin and disengage push rod eye.

3. Remove four right hand nuts holding power brake unit to dash panel.

4. Disconnect vacuum hose from cylinder.

5. Remove power brake unit from car, being careful not to drip brake fluid on car paint.

6. Remove filler cap and diaphragm and turn unit so that any brake fluid will drain out. Pump push rod by hand for full interior drainage. Discard old fluid. Install filler cap and diaphragm and cover hydraulic cylinder outlet with tape to exclude dirt. Clean all loose dirt from outside of unit before disassembling.

b. Installation of Power Brake Unit

1. Place power brake unit in position. Install four nuts on studs, and torque to 20-28 ft. lbs.

2. Install push rod eye over pedal pin. Install special washer and retainer.

3. Connect brake pipe to hydraulic cylinder.

4. Connect vacuum hose to check valve on front housing.

5. Bleed hydraulic system according to procedure in paragraph 9-6. Bleed left front wheel cylinder first and check for proper pedal feel. If system still has air in it, bleed other three wheel cylinders.

6. After bleeding, bring fluid level to 1/8" below lip of reservoir opening and install reservoir lid.

NOTE: When pressure bleeding equipment is not available, do not use any vacuum assist. The engine should not be running and the vacuum reserve should be used up by repeatedly applying the brake before starting the bleeding procedure.

7. Check pedal for full return and check stop light switch adjustment as described in paragraph 9-7 (b).

c. Testing Power Brake Unit

1. Vacuum Assist. With engine stopped, apply brake several times until all vacuum reserve in system is used up. Then depress brake pedal and start engine while holding a light pedal pressure. If vacuum system is operating properly, pedal will tend to fall away from under the foot, and less foot pressure will be required to hold pedal in same position. If no action is felt, vacuum system is not functioning.

2. Hydraulic Leak. Apply a heavy foot pressure on brake pedal with engine running. Hold this pressure at least 15 seconds and observe brake pedal. If pedal goes down gradually, check first for a leak in system outside of power brake unit. When possibility of an external leak is eliminated, leak is in hydraulic cylinder of power brake unit.

3. Vacuum Leak. Allow engine to idle a minute to build-up vacuum reserve. Shut off engine and wait several minutes at least (system should hold vacuum for 12 hours) before trying brake action. If brake is not vacuum assisted for at least 2 or more slow applications, there is a leak in the vacuum system. Always check for an external leak before blaming leak on power brake unit.

4. Road Test. Apply brakes several times at about 20 MPH to determine if a light pedal pressure stops the car evenly and quickly. Notice pedal feel as compared to other cars of the same model.

d. Trouble-Shooting Power Brakes

Many brake troubles which are blamed on the power brake unit may actually be caused by a defect outside of this unit. Since the brake system beyond the master cylinder is the same in either a standard or a power brake car, one brake trouble-shooting procedure is provided for all cars. See paragraph 9-5.

9-16 DISASSEMBLY, INSPECTION, ASSEMBLY OF POWER BRAKE UNIT

NOTE: Refer to Figures 9-17 through 9-21 for identification of parts not shown in figures next to overhaul steps.

a. Disassembly of Power Brake Unit

1. Place power brake unit in a vise with push rod up. Clamp unit firmly on sides of master cylinder reservoir.

2. Place a long wooden hammer handle in position to bear against two studs. Rotate rear housing counterclockwise to separate rear housing from front housing. Do not put pressure against plastic power piston tube.

3. Lift rear housing assembly and power piston assembly from unit.

4. Remove power piston assembly from rear housing and lay power piston aside in a clean place. Lay rear housing assembly aside.

5. Remove power piston return spring from front housing.

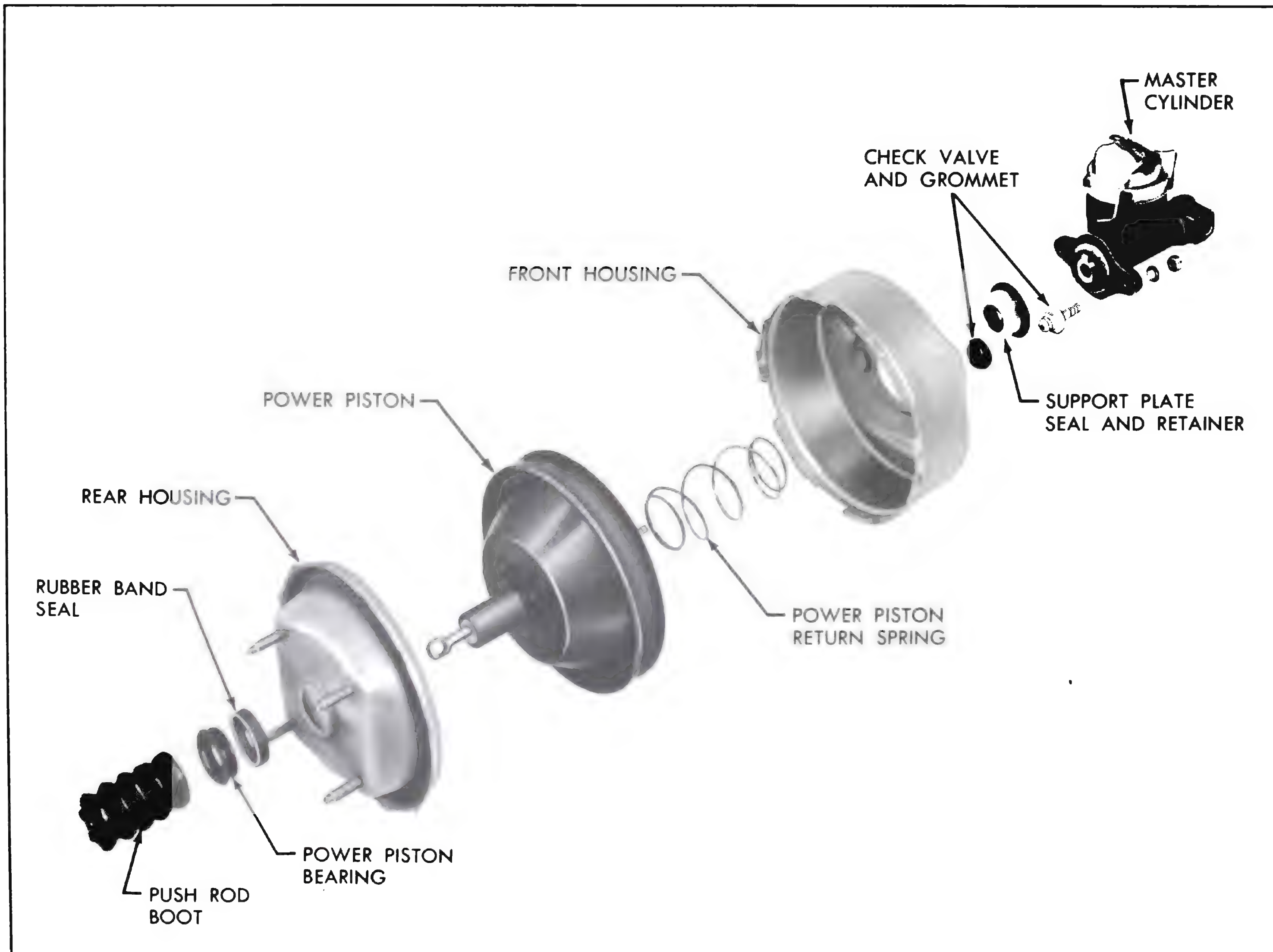


Figure 9-20—Power Brake Unit - Exploded View

NOTE: If front housing rubber parts or master cylinder need replacement or overhaul, it will be necessary to complete disassembly as follows in Steps 6, 7, and 8. Otherwise, there is no need to remove front housing from master cylinder.

6. To disassemble front housing from master cylinder, reposition master cylinder in vise to aid removal. Remove two retaining nuts and washers, and remove master cylinder from studs.

7. Remove support plate seal retainer from center of front housing. Remove seal from inside retainer. From O.D. of retainer, remove gasket. See Figure 9-21.

8. From housing, remove vacuum check valve and grommet. Lay aside in a clean place all disassembled front housing parts and master cylinder.

9. From center hole in rear housing, remove the boot, rubber band seal and power piston bearing. See Figure 9-20.

10. On the power piston assembly, loosen three special hex head retaining screws. With the master cylinder push rod up, remove the screws and lift the master cylinder push rod and rolling diaphragm support plate assembly from the power piston assembly. See Figure 9-23.

11. Remove the three (3) reaction levers from their seats in the power piston insert. Remove the air valve spring from the counterbore of the air valve. The push rod air valve assembly can be pushed through the power piston from the push rod end. The snubber and "O" ring can now be removed from the grooves in the air valve. See Figure 9-24.

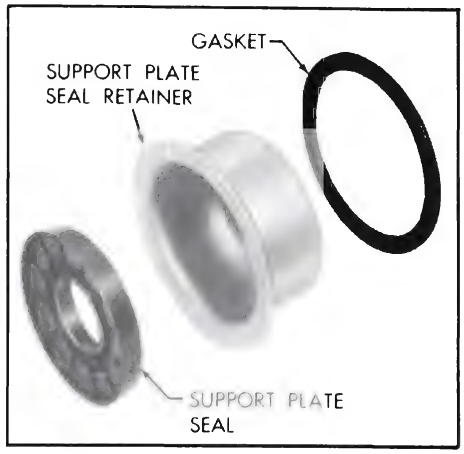


Figure 9-21—Support Plate Seal Assembly

12. Remove the power piston insert from the center of the piston. From the two (2) grooves in the O.D. of the insert, remove the two (2) "O" ring seals. See Figure 9-24.

13. Push the floating control valve assembly from its position in the

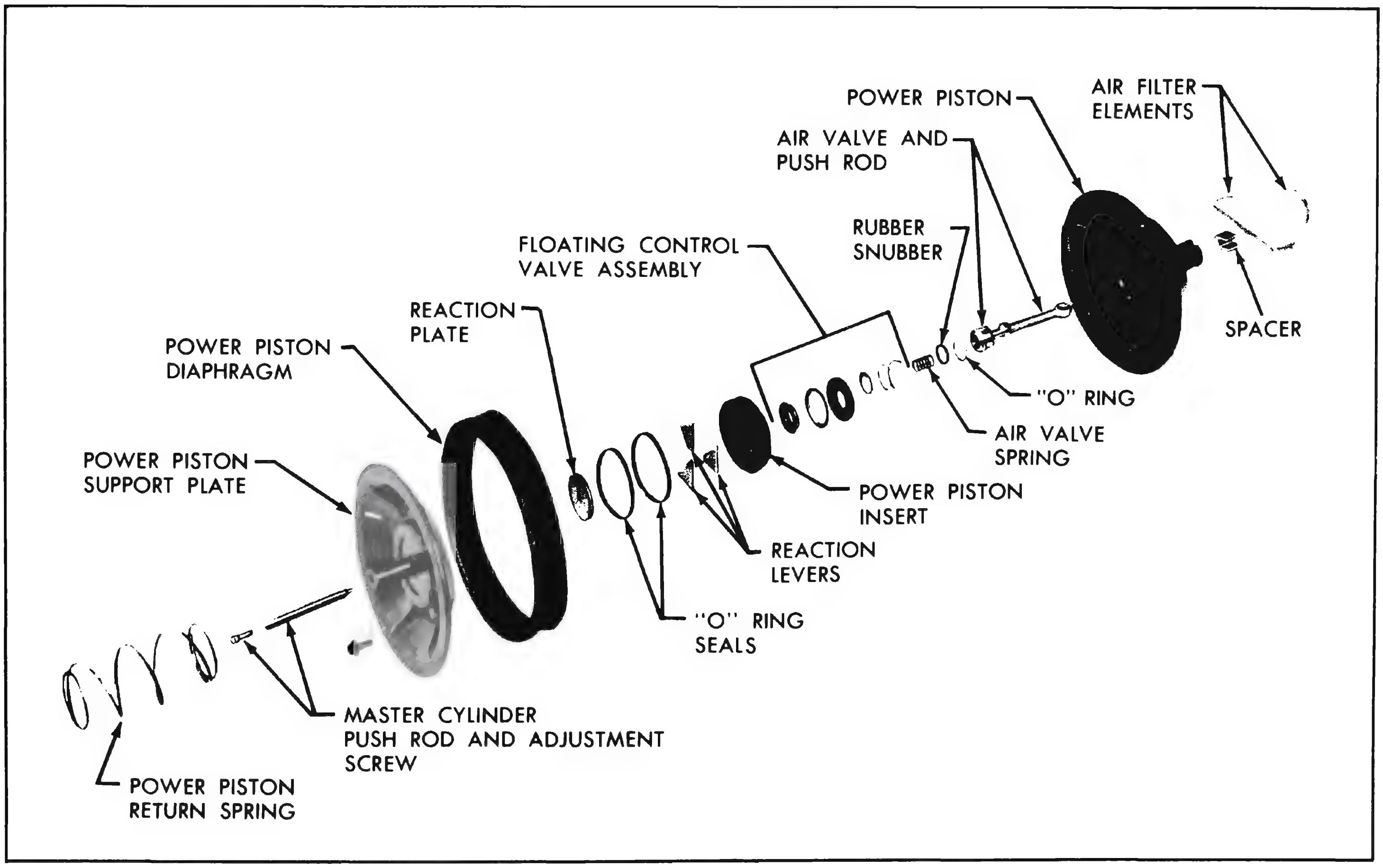


Figure 9-22—Power Piston Assembly - Exploded View

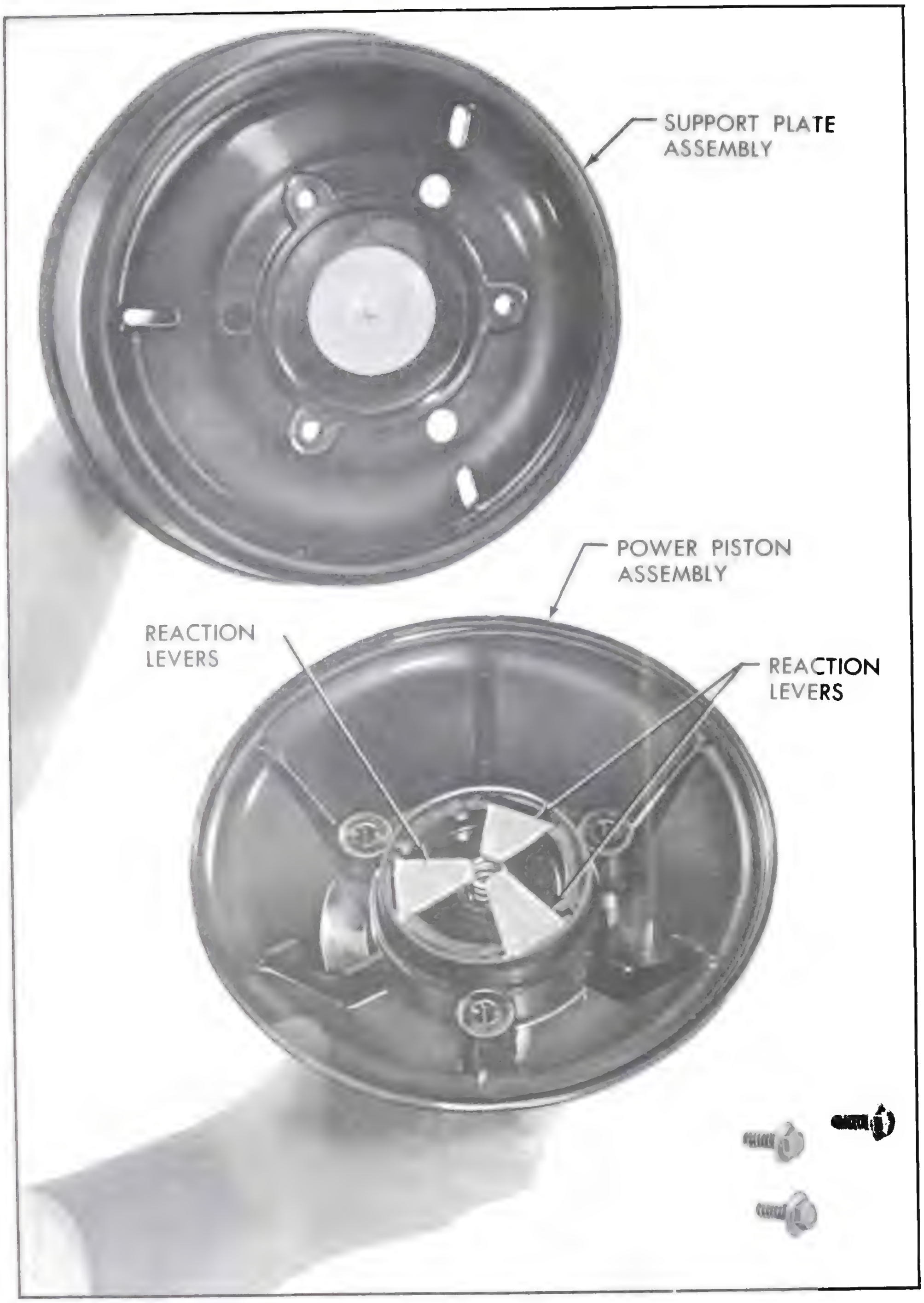


Figure 9-23—Removing Support Plate Assembly from Power Piston Assembly

center of power piston. The removal of the floating control valve exposes the floating control valve spring for removal. See Figure 9-25.

14. From the master cylinder push rod and the diaphragm support plate assembly, remove the power piston diaphragm and inspect for cuts, pin holes, distortion or cracks.

15. The master cylinder push rod can be pushed from the center of the support plate. If necessary, the master cylinder reaction plate can be removed from the push rod by pressing the plate off of the small, knurled end of the rod.

The adjusting screw in the end of the master cylinder push rod need not be removed.

16. From groove in O.D. of master cylinder open end, remove air filter.

17. From master cylinder bore, remove snap ring, master cylinder piston, primary cup, spring and retainer assembly, check valve assembly and valve seat washer. See Figure 9-26.

18. Remove master cylinder reservoir cap and rubber diaphragm.

b. Cleaning, Inspection, Replacement of Parts

As an aid in determining the cause of improper power brake operation, wipe fluid from all rubber parts, then carefully examine these parts for nicks, cuts or other damage. After examination discard all these parts.

Thoroughly clean the remaining parts in diacetone alcohol or clean brake fluid. Blow out all passages, orifices, or holes.

CAUTION: Do not use anti-freeze alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil, as this could cause serious damage to all rubber parts in the brake system.

Carefully examine the cleaned parts for nicks, burrs, stripped threads, damage or excessive wear. Replace damaged or excessively worn parts or housings. If inside of vacuum power cylinder is rusted or corroded, polish with steel wool or fine emery cloth. Replace if scored.

Make certain that the small compensating port in the master cylinder reservoir is clear.

If the outer surface of the air valve or the master cylinder piston show evidence of abrasion, polish out light scores with crocus cloth or very fine polishing

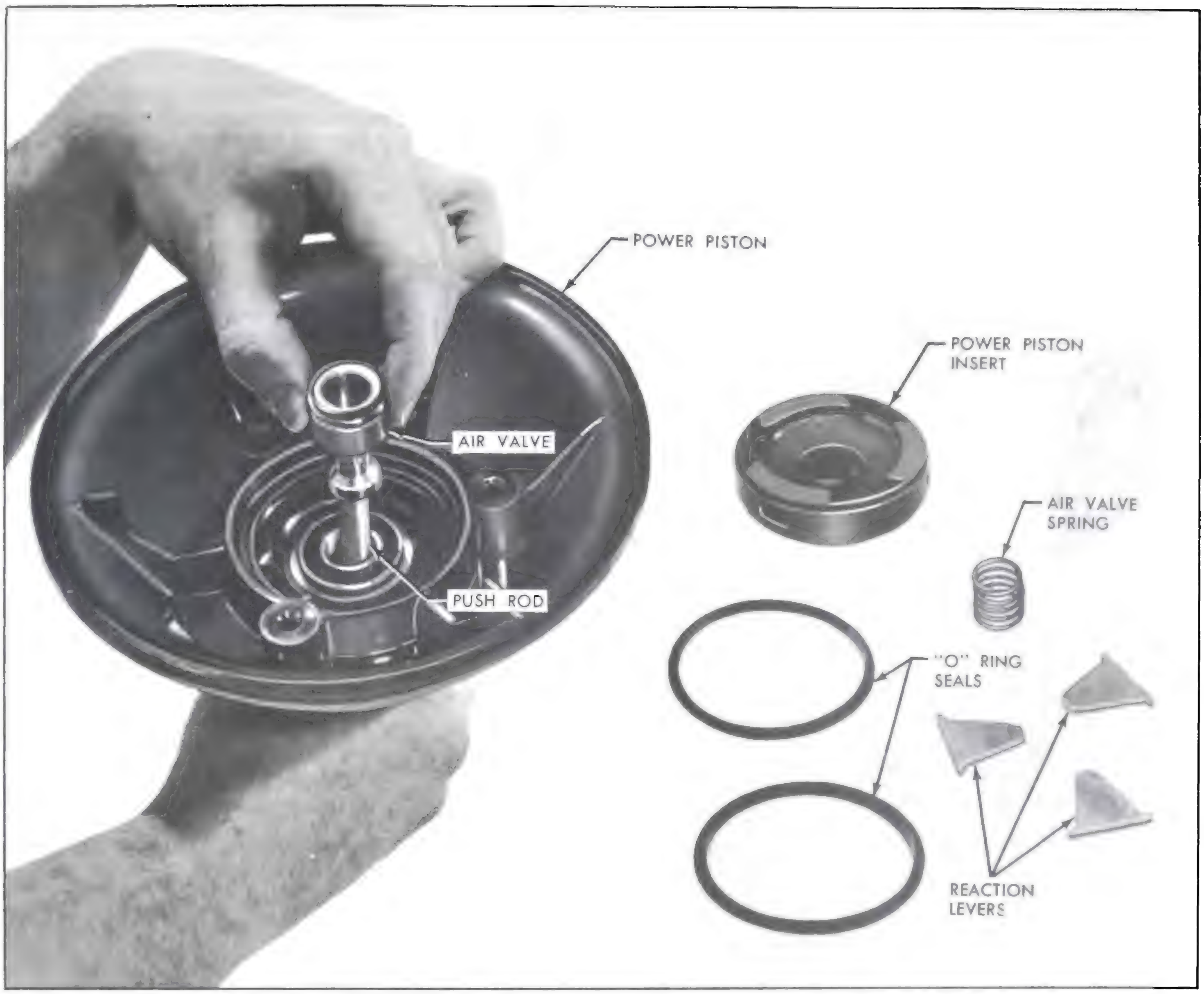


Figure 9-24—Removing Power Piston Parts

paper, then wash and dry thoroughly. Inspect master cylinder bore for corrosion or pits.

If any parts indicate that heavy corrosion or abrasive action has resulted from contamination of the brake fluid, replace damaged parts and be sure to thoroughly flush the reservoir and wheel cylinder lines.

The Power Brake Cylinder Overhaul Kit (Group 4.898) contains all necessary replacement parts for the power brake cylinder. When reassembling the brake cylinder use all the new parts in the kit regardless of whether the old parts appear fit for use. Discard all old rubber parts. In addition, replace any other parts which inspection indicates to be unfit for use.

Lubricate all hydraulic master cylinder parts with clean brake fluid. Lubricate vacuum power cylinder parts with silicone grease as specified. The recommended silicone grease is supplied in the power brake cylinder overhaul kit. Do not lubricate parts until just before installation.

c. Assembly of Power Brake Unit

1. Install master cylinder filler cap and diaphragm.

2. Place assembly in vise with master cylinder bore up and clamp firmly on sides of master cylinder reservoir.

3. Wipe master cylinder bore with a coat of clean brake fluid. Into bore, place valve seat washer. See Figure 9-26. Press check valve in open end of spring and retainer; place assembly in

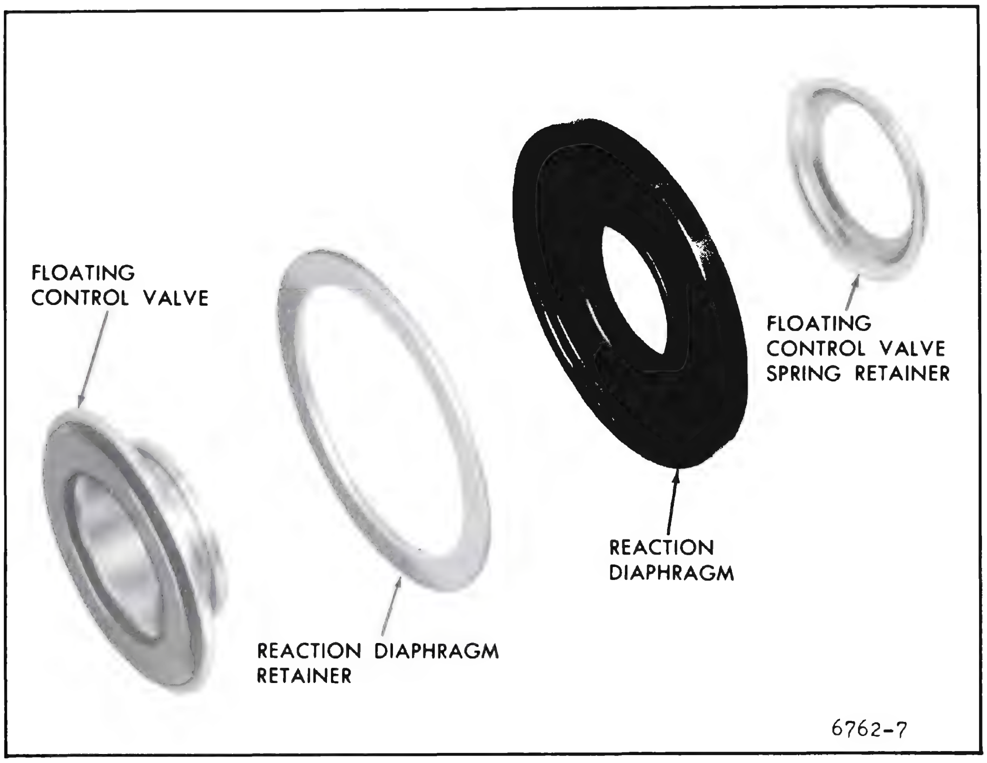


Figure 9-25—Floating Control Valve Assembly

bore with check valve down. Dip primary cup in clean brake fluid and place in bore with lip down. Insert master cylinder piston and place snap ring in place. Place a new filter in groove in open end of master cylinder.

4. To reassemble rear housing, replace power piston bearing in center hole of housing, with large flange to the outside. Lubricate grooves in I.D. of power piston bearing with power brake silicone lubricant. Place flat rubber band over O.D. of seal so that it covers joint where bearing and rear housing meet. Stretch the push rod boot over the O.D. of power piston bearing.

5. To reassemble front housing, replace vacuum check valve, using new grommet if old one is cracked or damaged.

6. Place new support plate seal in support plate seal retainer so that flat surface of cup lies against bottom of retainer. Place new gasket on O.D. of support plate seal retainer, and insert it into front housing so that gasket is between flange on retainer and surface of front housing. See Figure 9-21.

7. To reassemble support plate assembly, press the hydraulic reaction plate over the small,

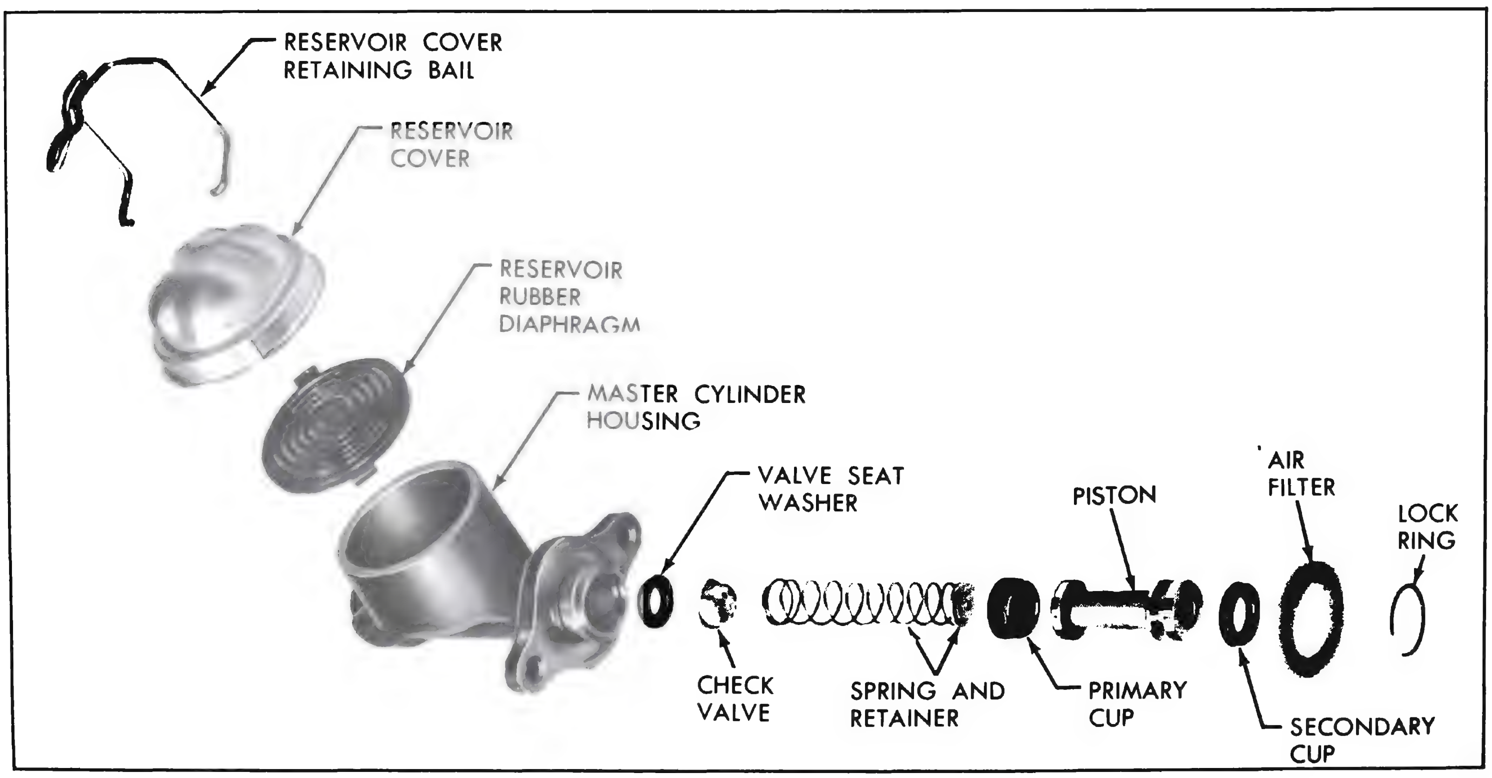


Figure 9-26—Master Cylinder - Exploded View

knurled end of the master cylinder push rod so that it lies against the shoulder of the push rod. The master cylinder push rod is now inserted through the support plate so that the hydraulic reaction plate lies flat against rear side of support plate. See Figure 9-27.

8. Reassemble power piston assembly by positioning the power piston in a vise with the long tube down. (DO NOT CLAMP). Place the floating valve spring in the center of the power piston.

9. Assemble the floating valve diaphragm over the flanged hub of the floating control valve. The flat surface of the diaphragm will be on the opposite side from the rubber face on the floating control valve. Insert the control valve diaphragm plate under the lip of the valve diaphragm. Place the spring retainer down over the hub of the floating control valve. See Figure 9-25.

10. Place a thin film of power brake silicone lubricant on the O.D. of the valve diaphragm. Press the floating control valve and diaphragm assembly to seat in the power piston, making sure that the floating valve spring seats on the spring retainer.

NOTE: Check that the rubber diaphragm is not distorted, as the assembly is pressed into the power piston.

11. Assemble the two (2) power piston insert "O" ring seals in the two (2) grooves in the O.D. of the power piston insert. See Figure 9-22. Press the insert to seat in the power piston.

12. Install the air valve "O" ring into the groove in the O.D. of the air valve. Place the air valve bumper over the flanged end of the air valve. See Figure 9-27. Lubricate the "O" ring with power brake silicone lubricant and press the air valve (push rod first) into the power piston insert.

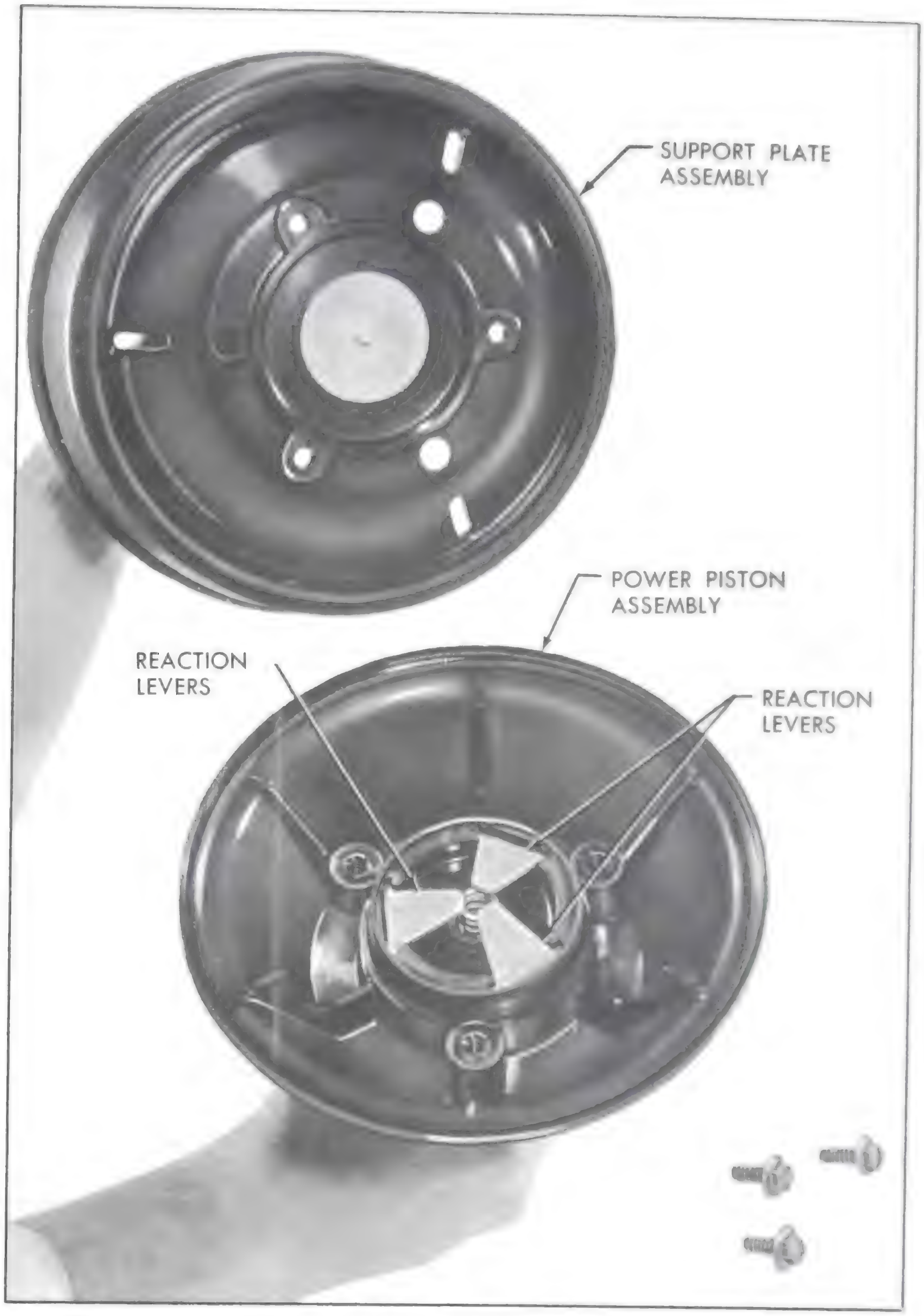


Figure 9-27—Installing Parts into Power Piston

13. Place the air valve spring into the counterbored end of the air valve. Position the ears of the reaction levers in the molded locations in the power piston insert and rest the small ends of the levers on the air valve spring. See Figure 9-27.

14. Place the unfolded diaphragm over the support plate so that the raised bead on the small I.D. of the diaphragm faces away from the support plate. Position the power piston support plate assembly on the power piston, making sure that the beaded edge of the diaphragm is located between the flange on the support plate assembly and the flange on the edge of the power piston assembly.

NOTE: When locating the power piston support plate on the power piston, be sure that the reaction levers maintain their positions in the seats in the power piston insert, as the support plate contacts the power piston. (Torque to 80-100 inch pounds).

15. Wrap the first piece of filter material around the push rod and press down into the power piston tube.

16. To complete assembly of overall power brake unit, clamp the front housing and master cylinder assembly in a vise, with open end of the master cylinder bore accessible. Place the power piston return spring to seat over the support plate seal retainer.

17. Lubricate lightly with power brake silicone lubricant, both the tube extension on the master cylinder end of the power piston, as well as the tube extension on the push rod end. Also, lubricate lightly with talcum powder the beaded edge of the rolling diaphragm. This is done to ease the assembly of the rear housing.

18. Insert the power piston, push rod first, into the rear housing. The extension on the end of the power piston will fit through the power piston bearing and the push rod through the boot. Fold the rolling diaphragm back into position on the rear housing flange.

19. Place the rear housing and power piston assembly into front housing. Line up the scribe mark on the top of the housing so that when the housing is rotated into the locked position, the scribe mark will be in line with the scribe mark on the front housing.

20. Place a long wooden hammer handle in position to bear on the rear housing studs. Press down and check to be sure that the bend on the edge of the rolling diaphragm is correctly positioned between the edges of the front and rear housings. If this is satisfactory, put additional pressure down on the rear housing, and at the same time, rotate the housing clockwise into the locked position.

CAUTION: Do not put pressure on the plastic power piston tube, when locking the housings. Care must be taken not to damage or loosen studs in rear housing.

d. Gauging Power Brake Piston

The following gauging operation is necessary only when a major structural part such as the front or rear housing, the power piston assembly, the master cylinder piston, or the master cylinder assembly is replaced with a new part. The gauge measures how far the master cylinder push rod projects from the front housing. This dimension must be correct to insure the proper clearance on the master cylinder between the primary cup and the compensating port.

Make check as follows:

1. Remove master cylinder assembly from front housing by removing two nuts and lock washers; then pull master cylinder from front housing. (Do not disturb support plate seal retainer.)

2. Place Gauge J-7723-01 so that it stands perpendicular to front housing next to two studs, and bridges over end of master cylinder push rod. Push rod should be flush with gauge. See Figure 9-28.

3. Adjust screw in end of push rod to match height of gauge.

4. Insert master cylinder on studs and press into housing. Install two lock washers and nuts. Torque nuts to 15-20 ft. lbs.

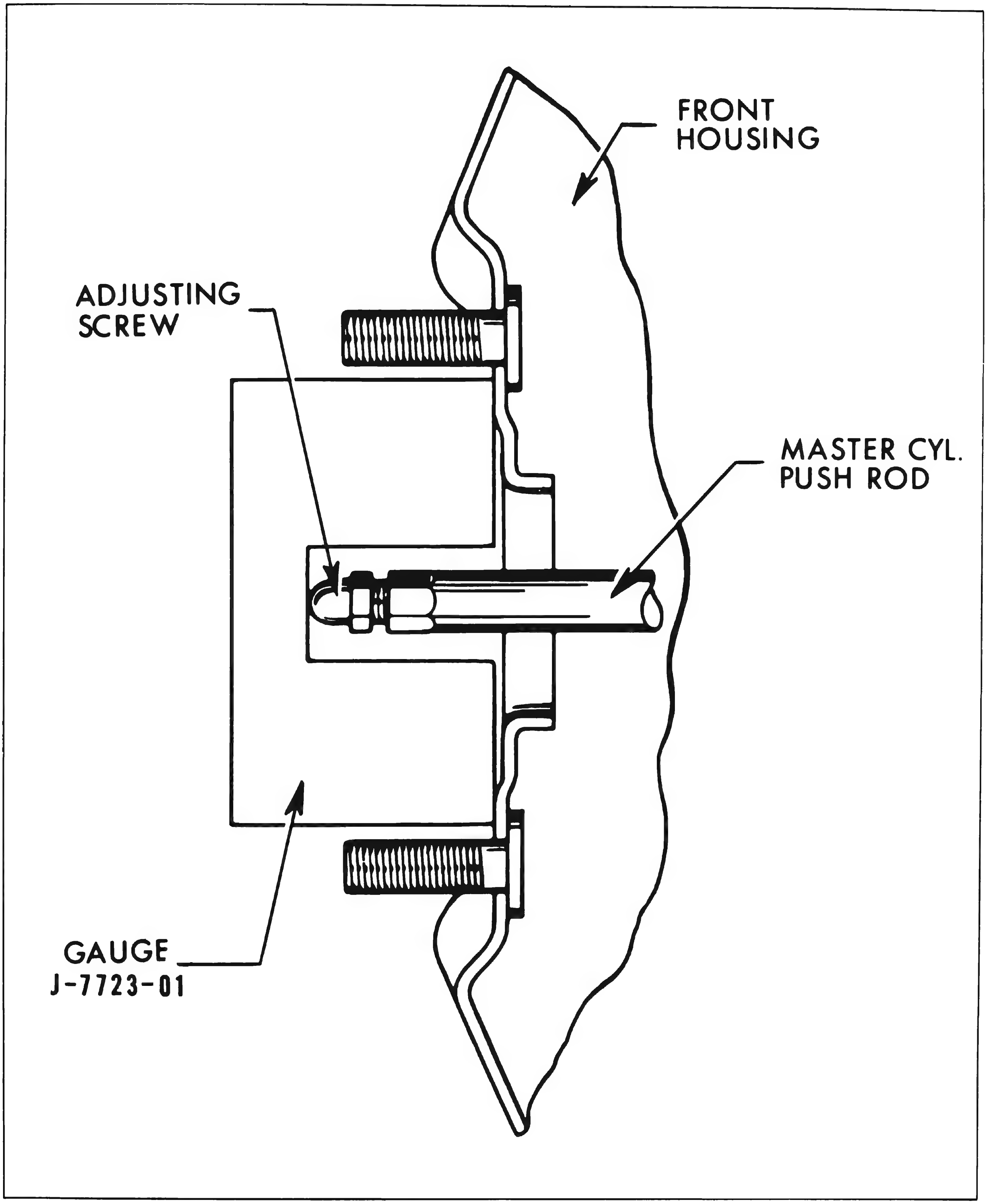


Figure 9-28—Gauging Master Cylinder Push Rod

GROUP 10

ELECTRICAL SYSTEMS

SECTIONS IN GROUP 10

SECTION 10-A

ELECTRICAL SPECIFICATIONS

CONTENTS OF SECTION 10-A

10-1 BATTERY SPECIFICATIONS

Item	4400	46-47-4800
Make	Delco	Delco
Model	1980558	1980570
Location Under Hood	R.F. Fender Skirt	L.F. Fender Skirt
Terminal Grounded	Negative	Negative
Voltage	12	12
Capacity—Wet (Amps. Hrs.@ 20 Hr. Rate)	61	70
Number of Cells & Plates/Cell	6, 11	6, 11
Specific Gravity, Full Charge @ 80° F.	1.260 to 1.280	1.260 to 1.280
Bench Charging Rate, Start	5 Amps.	5 Amps.
Bench Charging Rate, Finish	2 Amps.	2 Amps.
Separators	Porous Rubber	Porous Rubber
Case	Hard Rubber	Hard Rubber
Dimensions	10 1/4" x 6 13/16" x 8 27/32" High	12 1/32" x 6 13/16" x 8 13/16" High

10-2 GENERATING SYSTEM SPECIFICATIONS

a. Generator

Make and Type	Delco-Remy, Delcotron
Location, Side of Engine	Upper Right
Drive and Rotation (Viewing Drive End)	Fan Belt, Clockwise

	Standard		Air Condition	
	4400	46-47-4800	4400	46-47-4800
Number	1100624	1100623	1100679	1100661
Speed Ratio, Gen. to Engine	2.34 to 1	2.52 to 1	2.67 to 1	2.75 to 1
Field Current Draw (Amps.) @ 80° F. and 12 Volts	1.9 to 2.3	1.9 to 2.3	2.1 to 2.5	2.1 to 2.5
Bench Test at 14 Volts (Amps. Cold @ Gen. RPM)	42 @ 6500	42 @ 6500	55 @ 6500	55 @ 6500
Min. Current Output @ 500 Eng. RPM	10 Amps.	10 Amps.	10 Amps.	10 Amps.
Min. Current Output @ 1500 Eng. RPM	30 Amps.	30 Amps.	40 Amps.	40 Amps.
Belt Tension	80 Lbs.	80 Lbs.	80 Lbs.	110 Lbs.

b. Generator Regulator

Make and Type	Delco-Remy, Double Contact
Number	1119515
Field Relay Air Gap	.015"
Field Relay Closing Voltage	2.3 to 3.7
Voltage Regulator Air Gap, Lower Points Just Touching	.060"
Voltage Regulator Upper Contact Point Opening	.014"
Voltage Regulator Upper Contact Setting @ 2000 Eng. RPM (After 15 Min. Warm-Up @ 1500 Eng. RPM)	See Figure 10-21
Voltage Regulator Lower Contact Setting (Step Voltage)	.1 to .3 Below Upper Setting

c. Police Car Generator

Make and Type	Delco-Remy, Delcotron
Number	1117765
Location, Side of Engine	Right
Drive and Rotation (Viewing Drive End)	Fan Belt, Clockwise
Speed Ratio, Generator to Engine	2.62 to 1
Field Current Draw (Amps.) @ 80° F. and 12 Volts	3.7 to 4.4
Bench Test at 14 Volts (Amps. Cold @ Generator RPM)	62 @ 6500
Current Output @ 500 Engine RPM	20 Amps. Min.
Current Output @ 1500 Engine RPM	50 Amps. Min.
Belt Tension	80 lbs.

d. Police Car Generator Regulator

Make and Type	Delco-Remy, Transistor
Number	9000590
Point Gap and Air Gap	None, No Moving Parts
Voltage Setting @ 1500 Engine RPM	14 ± .3 Volts

e. Police Car Indicator Light and Field Relay

Make and Type	Delco-Remy, Single Contact
Number	1115827
Air Gap, Points Just Touching	.011" to .018"
Point Opening	.020" to .030"
Closing Voltage	2.5 to 3.5 Volts

10-3 CRANKING (STARTER) SYSTEM SPECIFICATIONS

a. Cranking Motor

	Series 4400	Series 46-47-4800
Make	Delco-Remy	Delco-Remy
Number	1107306	1107313
Location, Side of Engine	Right	Left
Type of Shift	Mechanical	Mechanical
Shift Actuation	Solenoid	Solenoid
Shift Operation	Ignition Switch	Ignition Switch
Type of Drive	Overrunning Clutch	Overrunning Clutch
Rotation, Viewing Drive End	Clockwise	Clockwise
Gear Ratio, Motor to Engine	17.8 to 1	18.4 to 1
No. Teeth on Ring Gear and Drive Pinion	160, 9	166, 9
Cranking Speed, Engine RPM (at Operating Temperature)	160 Approx.	160 Approx.
No Load Test		
Amperes	65 to 100	80 to 120
Volts	10.6	10.6
RPM	3600 to 5100	3900 to 5400
Locked Armature Test		
Amperes	300 to 360	290 to 370
Volts	3.5	2.0
Brush Spring Tension - Ounces	35 min.	35 min.
Armature End Play	.005" to .050"	.005" to .050"
Pinion Clearance in Cranking Position	.010" to .140"	.010" to .140"

b. Solenoid Switch

	Series 4400	Series 46-47-4800
Make	Delco-Remy	Delco-Remy
Solenoid Switch Number	1114341	1114339
Current Draw of Solenoid Windings @ 80° F.		
Hold-in Winding, Amps. @ 10 Volts	10.5 - 12.5	14.5 - 16.5
Both Windings in Parallel, Amps. @ 10 Volts	42 - 49	41 - 47

10-4 IGNITION SYSTEM SPECIFICATIONS

a. Ignition Coil and Resistor

Make	Delco-Remy
Coil Number (Less Bracket)	1115087
Current Draw, Amperes @ 12.6 Volts	
Engine Stopped	3.8
Engine Idling	2.3
Coil Resistance (Ohms) @ 80° F.	
Primary	1.28 to 1.42
Secondary	7200 to 9500
Resistance Wire	Part of Wiring Harness
Resistance, Ohms @ 80° F.	1.80 ± .05

b. Spark Plugs

	300 Engine	401 & 425 Engines
Make and Model (for Normal Operation)	AC 44FFS	AC 44S
Make and Model (for High Speed Operation)	AC 42FF	AC 42 COM
Thread and Shell Hex. Sizes	14MM, 13/16"	14MM, 13/16"
Gap at Points	.035"	.035"
Tightening Torque (ft. lbs.)	20	30

c. Distributor

Make	Delco-Remy
Drive	From Camshaft
Rotation, Top View	Clockwise
Vacuum Control Number	1116210
Firing Order (300 Engine)	1-8-4-3-6-5-7-2
Firing Order (401 and 425 Engines)	1-2-7-8-4-5-6-3
Contact Point Opening	.016" ± .003"
Contact Point Dwell Angle	30° ± 1°
Dwell Variation	3° Max.
Breaker Arm Spring Tension, Ounces	19 to 23
Condenser Make and Capacity, Microfarads	Delco-Remy, .18 to .23

	300 Engine	401 & 425 Engines (Except Dual 4-Bbl. with Auto. Trans.)	425 Engine* (Dual 4-Bbl. with Auto. Trans.)
Distributor Number (less Cap)	1111050	1111055	1111058
Timing, Crankshaft Degrees before U.D.C. (with Vacuum Hose Disconnected and Engine Idling)	2 1/2°	2 1/2°	12°
Centrifugal Advance, Crankshaft Degrees and RPM			
Start Advance, @ RPM	550 to 750	600 to 800	550 to 950
Medium Advance, Degrees @ RPM	12° to 16° @ 1400	13° to 17° @ 1400	1/2° to 4 1/2° @ 1000
Maximum Advance, Degrees @ RPM	26° to 30° @ 4200	28° to 32° @ 3900	18° to 22° @ 3800
Vacuum Advance, Crankshaft Degrees and Inches of Vacuum			
Start Advance, @ In. of Vacuum	6 to 8	6 to 8	6 to 8
Maximum Advance, Degrees @ In. of Vacuum	14° to 18° @ 16	14° to 18° @ 16	14° to 18° @ 16

10-5 LIGHTING SYSTEM SPECIFICATIONS

a. Lamps, Switches, Wiring

Headlamp Make and Type	Guide, Dual T-3 Sealed Beam
Headlamp Lens Diameter	5 3/4"
Tail, Stop, Parking, Signal Lamps, Make	Guide
Lighting Switch, Make	Delco-Remy
Wiring Circuit Type	Single Wire
Wiring Circuit Protection for Head and Front Parking Lights	Thermo Circuit Breaker
Thermo Circuit Breaker Location	In Lighting Switch
Thermo Circuit Breaker Calibration @ 75° F.	
Stay Closed Indefinitely @ Amps	15
Open Within 60 Seconds @ Amps	26

b. Fuses and Circuit Breakers

Used For	Type	Location
Back-up Lights	10 Amp. 1 1/4"	Fuse Block
Blower, Heater-Air Conditioner, and Compressor Clutch	30 Amp. 1 1/4"	Fuse Block
Courtesy and Glove Box Lights, Clock	5 Amp. 1 1/4"	Fuse Block
Direction Signal, Signal Indicator and Stop Lights	10 Amp. 1 1/4"	Fuse Block
Dome Light, Trunk Light and Rear Cigar Lighter	20 Amp. 1 1/4"	Fuse Block
Guide-Matic Amplifier	5 Amp. 1 1/4"	Fuse Block
Panel Lights and Rheostat	3 Amp. 1 1/4"	Fuse Block
Parking Brake Light, Safety Buzzer or Cruise Control	6 Amp. 7/8"	Fuse Block
Power Antenna Motor	9 Amp. 7/8"	Fuse Block
Radio and Dial Light (Sonomatic)	2.5 Amp. 7/8"	Fuse Block
Radio and Dial Light (Wonder Bar)	7.5 Amp. 7/8"	Fuse Block
Rear Window Defroster	6 Amp. 7/8"	Fuse Block
Tail, License and Cornering Lights, Panel Lights and Rheostat	10 Amp. 1 1/4"	Fuse Block
Wiper and Washer Motor, Transmission Solenoids	25 Amp. 1 1/4"	Fuse Block
Cigar Lighter	Special	In Back of Lighter
Headlights, Front Parking Lights	Circuit Breaker	In Light Switch
Power Windows, Vents, Top and Seat	Circuit Breaker	Under Left Kick Pad
Tail Gate Wiper and Washer	20 Amp. 1 1/4"	In Wiring Connector

c. Lamp Bulbs

Location	Bulb. No.	Candlepower
Ash Tray	1445	.5
Ash Tray (4700)	53	1
Auto. Trans. Control Dial (Console)	1816	3
Auto. Trans. Control Dial (Instrument Panel)	194	2
Back-Up	1156	32
Clock Dial	1893	2
Cornering	1195	50
Courtesy, Console, Rear Seat Side Rail or Arm Rest	90	6
Cruise Control Dial	53	1
Dome, Center Roof	1004	15
Glove Box	1893	2
Headlight High Beam Indicator	194	2
Headlight, 5 3/4" Dia., Type 1 (Inner)	4001	37.5 Watts
Headlight, 5 3/4" Dia., Type 2 (Outer)	4002-L	37.5-55 Watts
Heater-Air Conditioner Control Dial	1893	2
Ignition Switch	1445	.5
Indicator Lights (Hot, Cold, Oil and Amp.)	194	2
Instrument Cluster Dials	161	1
License	1155	4
Parking Brake Warning	1816	3
Parking, Lower (4700)	1155	4
Radio Dial	1881	1
Turn Signal and Parking, Front	1157A	32-4
Turn Signal, Tail and Stop, Rear	1157	32-4
Turn Signal Indicator	194	2
Trunk	89	6

10-6 SIGNAL SYSTEMS SPECIFICATIONS

Stop Light Switch, Type	Mechanical
Stop Light Switch, Location	Pedal Mounting Bracket
Direction Signal Switch, Make	Delco-Remy
Direction Signal Flasher, Make and Type	Tung-Sol, A-418B
Location	Fuse Block
Design Load	2 - 32 CP Bulbs
Flash Rate, Cycles per Min.	60 to 120
Lamp Bulbs - No. and Candle Power	See Par. 10-5, c
Direction Signal and Stop Light Fuse	See Par. 10-5, b
Horn - Make and Type	Delco-Remy, Solenoid
Horn Number, High Note	9000470
Low Note	9000469
Horn Amperage Draw at 12 Volts (Either Horn)	4.5 to 5.5
Horn Relay and Junction Block Number	382429
Horn Relay Adjustment	
Closing Voltage	3.0 to 9.0
Speed Warning Buzzer Number	1361529
Amperage Draw @ 14.5 Volts	.14 Max.

SECTION 10-B

BATTERY AND CABLES

CONTENTS OF SECTION 10-B

10-7 GENERAL BATTERY INFORMATION

Delco-Remy 12-volt storage battery model 570 is used in all models. This battery has 6 cells with 11 plates per cell, a capacity of 70 ampere-hours at a 20 hour rate, and a rating of 840 watt-hours.

The battery is mounted on the left front fender skirt under the hood. The battery negative (-) post is grounded to the engine cylinder head by a copper cable. The positive (+) post is connected by an insulated copper cable to a junction block on the fender skirt.

a. Registration of Battery

Delco-Remy Battery dealers and distributors are prepared to carry out terms of the manufacturer's warranty on Delco-Remy batteries. In order that Buick owners shall have the protection and benefit of this warranty, it is necessary for the dealer or car owner to register his battery with the local Delco-Remy Battery dealer or distributor on all new car deliveries, and on all deliveries of new replacement Delco-Remy batteries. The Battery Owner's Certificate is located in the Owner's Protection Plan Booklet.

Figure 10-1—Battery

b. Care of Wet Batteries in Storage

Batteries in stored new cars, as well as batteries in stock, must be given regular attention to prevent sulphation of plates that may result from inactivity and self-discharge. All automotive wet batteries will slowly discharge on standing idle, whether in stored vehicles or in stock, and will self-discharge much faster when warm than when cold. Batteries in stock should be rotated and the older ones used first.

To minimize the extent of self-discharge always store batteries fully charged and in cool place where the temperature does not go below freezing. Every 30 days check the level of electrolyte, add water as required and charge the batteries at a 5 ampere rate until fully charged.

Batteries used for display purposes or standing in cars in storage must be treated in the same manner as batteries in stock.

When a new car, or a new replacement battery is delivered, make certain that it is fully charged and the electrolyte is at proper level. This is extremely important because the delivery of a partially discharged battery may not only lead to its return for charging but may also result in shortened life of battery.

c. Importance of Maintaining Electrolyte at Proper Level

Water is the only component of the battery which is lost as the result of charging and discharging, and it must be replaced before the electrolyte level falls to the tops of the separators. If the water is not replaced and the plates become exposed, they may become permanently sulphated, which would impair the performance of the plates. Also, the plates cannot take full part in the battery action unless they are completely covered by the electrolyte.

d. Importance of Keeping Battery Properly Charged

The battery has three major functions: (1) It provides a source of energy for cranking the engine. (2) It acts as a stabilizer to the voltage in the electrical system. (3) It can for a limited time furnish energy when the demands of the electrical units in operation exceed the output of the generator.

In order for the battery to continue to function, it is necessary that current withdrawal from the battery be balanced by current input from the generator so that the battery is maintained in a properly charged condition. If the outgo exceeds the input the battery will become discharged so that it cannot supply sufficient energy.

The state of charge of the battery as well as the temperature of the electrolyte has an important bearing on its capacity for supplying energy. Battery efficiency is greatly reduced by decreased electrolyte temperature as it has a decided numbing effect on its electrochemical action. Under high discharge such as cranking, battery voltage drops to lower values in cold temperatures than in warm temperatures.

In extremely cold climates it is important to keep batteries in a nearly full charged condition to avoid the possibility of freezing, which will damage any battery. The following table shows the temperatures at which freezing will occur in electrolytes of different densities, with specific gravity corrected to 80°F.

Specific Gravity	Freezing Point
1.220	-35°F.
1.200	-20°F.
1.160	0°F.

e. Care of Dry Batteries in Storage

A "dry charge" battery contains fully charged positive and negative plates but no electrolyte.

Dry charged batteries should be stored in a dry place away from excessive heat. A dry charged battery should be kept in its original carton until ready to be put into service. This type of battery will retain its "charged" condition indefinitely if protected from moisture. Dry batteries may be stacked in vertical columns provided they are not stacked more than four high.

f. Preparing Dry Charged Batteries for Service

To prepare "dry charge" batteries for service use approved battery-grade acid electrolyte (1.265 sp. gr. at 80°F). Care should be exercised in its use to prevent bodily injury or damage to clothing or other material resulting from actual contact with the electrolyte.

Electrolyte should be added to dry charged batteries in an area where water is readily available for flushing in case the electrolyte comes into contact with the body. Refer to instructions on side of electrolyte container for antidotes to use if electrolyte comes into contact with the body.

It is strongly recommended that a person filling batteries with electrolyte wear glasses (preferably safety glasses) to prevent possible damage to the eyes should any spattering of the electrolyte occur.

1. Remove dry charged battery from its original carton.

2. Remove the vent plugs.

3. Using a glass or acid-proof plastic funnel, fill each battery cell with electrolyte. Do not use a metal funnel for filling the battery. The cell is properly filled when the electrolyte level rises to the split ring at the bottom of the vent well. Do not overfill or underfill. Overfilling will cause acid corrosion in the battery area; underfilling will cause early battery failure.

4. After filling cells, wait five to ten minutes and add additional electrolyte, if necessary, to bring the electrolyte to the proper level.

5. Never finish filling a dry charge battery with water. If electrolyte is spilled, more electrolyte must be obtained.

g. Test After Batteries are Prepared for Service

The Delco Dry Charge Battery may be put into service immediately after activation. However, to insure good battery performance, the following activation tests are recommended.

1. After adding electrolyte, check the open circuit voltage. Less than 10 volts indicate a reverse cell or an open circuit and the battery should be replaced.

2. Check the specific gravity of all cells. If the specific gravity corrected to 80°F. shows more than a thirty point (.030) drop from the initial filling with electrolyte, or if one or more cells gas violently after addition of electrolyte, the battery should be fully charged before use.

3. For best performance in cold weather (32°F. or less), or if the battery and the electrolyte are not at 60°F. or above at time of activation, warm the battery by boost charging.

10-8 PERIODIC BATTERY INSPECTION AND SERVICE

The battery requires very little attention, but periodic inspection is essential to secure the maximum efficiency and life. The following services are essential to maintain the battery at maximum efficiency.

CAUTION: The gas which is produced in the battery cells during charging is dangerously explosive. Extreme care must be taken to avoid bringing open flames, lighted matches, etc., near a battery which is or has been recently on charge, and which is or has been gassing. Likewise care must be taken to avoid causing

any sparks near a battery with jumper cables or fast charger cables, since this can also set off an explosion of the gases.

a. Maintain Electrolyte Level

Add distilled water as required to maintain the electrolyte level at the split ring at bottom of filler well. See Figure 10-2. CAUTION: Do not overfill, as electrolyte may be sprayed out by gassing or may overflow due to heat expansion during charging.

If distilled water is not available, it is better to add clean, mineral-free tap water than to allow the electrolyte level to remain below the top of the plates.

In freezing weather the water should be added just before using the car or otherwise charging the battery so that the water will be mixed with the acid before it is allowed to stand in freezing temperatures.

If it is found necessary to add water to the battery more frequently than about every 1,000 miles and the quantity of water added per cell is great, check setting of voltage regulator and adjust, if necessary (par. 10-21). Abnormal water loss is an indication that the battery is being overcharged.

b. Inspect Battery, Mounting and Cables

Check outside of battery for damage or signs of serious abuse such as broken case or broken covers. Check inside of battery by removing the vent caps and inspecting for signs of abuse such as electrolyte level too low, or bad or unusual odors. If battery shows signs of serious damage or abuse, it should be replaced.

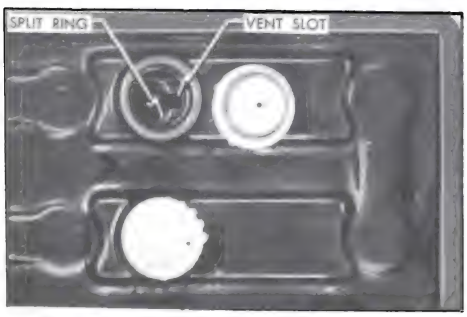


Figure 10-2—Battery Filler Well

Check the battery hold down bolts to make certain that battery is securely held in place. Excessive tightening may distort or crack the battery case.

If the top of battery is dirty or the hold down strap is corroded, clean thoroughly with a brush dipped in ammonia or soda solution. Care must be used to prevent any solution from getting into battery cells. After the foaming of solution stops, flush off with clean water and dry thoroughly. If hold down strap is corroded it should be painted with acid-resisting paint after cleaning.

Check battery cables to make certain they are tight at battery posts, engine mounting bracket and junction block. If a connection is found loose it should be cleaned before being tightened as arcing and corrosion may have taken place in the loose connection. Check condition of cables and replace if badly corroded or frayed. See paragraph 10-11 for instructions on cleaning and tightening cable terminals and replacement of cables.

10-9 LIGHT LOAD TEST OF BATTERY

The light load battery test is an in-the-car test designed to quickly determine the serviceability of any lead-acid battery. Nonuniform readings, as described in c below, are sufficient evidence for immediate replacement of the battery. This test is simpler and more conclusive than the hydrometer test; however, a cell voltage tester having .01 volt division is required. Before testing, visually inspect the battery as described in paragraph 10-8.

If battery passes visual inspection, check condition of battery cells as follows:

1. Add water to fill all cells to proper level.

2. Place load on battery by closing starter switch for 3 seconds. It makes no difference whether starter turns engine or not. However, if engine starts, turn off ignition immediately.

3. Turn headlights on low beam. After 1 minute, with lights still on, read individual cell voltages of battery with voltmeter having .01 volt divisions.

Compare readings with the following:

(a) Uniform Readings. If any cell reads 1.95 volts or more, and the difference between the highest and lowest cell is less than .05 volt (5 divisions), battery is good.

(b) Low Readings. If all cells read less than 1.95 volts, battery is too low to test properly. Failures of the meter to register on all cells does not indicate a defective battery. Quick-charge battery and repeat light loat test. See paragraph 10-12, subparagraph b. If none of the cells come up to 1.95 volts after the first quick-charge, the battery should be given a second charge. Batteries which do not come up after second quick-charge should be replaced.

(c) Nonuniform Readings. If any cell reads 1.95 volts or more and there is a difference of .05 volts (5 divisions) or more between the highest and lowest cell, battery should be replaced.

3. After test, close openings in sealing compound above cell connector straps. During light load test, if any cell reads below 2

Figure 10-3—Light Load Test

volts, battery should be charged before returning car to owner.

NOTE: If any battery found to be "good" by Light Load Test does not perform satisfactorily in subsequent service, it should again be tested by the Light Load Test and if it still tests "good", it should be removed from car and tested as outlined under Full Charge Hydrometer Test. See paragraph 10-10.

10-10 FULL CHARGE HYDROMETER TEST OF BATTERY AND USE OF HYDROMETER

a. Full Charge Hydrometer Test

The full charge hydrometer test should be used on any battery originally found to be "good" by the Light Load Test, but has since failed to perform satisfactorily in service and which still tests "good" by the Light Load Test.

IMPORTANT: The full charge hydrometer test is not valid unless battery has been tested and found to be "good" by the Light Load Test.

1. Fully charge battery as described under slow-charging (par. 10-12, subpar. a).

NOTE: Hydrometer reading taken on partially charged batteries are unreliable for this test.

2. Measure specific gravity of electrolyte in each cell and compare readings with the following:

(a) If cell readings range between 1.230 and 1.310, the battery is ready for use. All it needed was a full charge. Any variation in the specific gravity between cells within this range does not indicate a defective battery.

(b) If any cell reads less than 1.230 and:

(1) Battery has been in service 3 months or less, battery is good but it has been improperly filled with electrolyte or water and will give poor performance. To correct this condition, empty the electrolyte from any cell reading less than 1.230 and refill with 1.265 specific gravity battery grade electrolyte. The battery is now ready for use.

(2) Battery has been in service more than 3 months, it should be replaced.

(c) If any cells read above 1.310 battery may be returned to service. However, specific gravities above 1.310 are harmful to battery and will cause early failure. Such high readings are caused by improper addition of electrolyte. Adjusting the specific gravity will not correct the damage that has been done by high specific gravity.

b. Use of Hydometer

The hydrometer measures the percentage of sulphuric acid in the battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, the acid leaves the solution and enters the plates, causing a decrease in specific gravity of electrolyte. With a hydrometer, an indication of the concentration of the electrolyte is obtained.

The specific gravity of the electrolyte varies not only with the percentage of acid in the liquid, it also varies with temperature. As temperature increases, the electrolyte expands so that the specific gravity is reduced. As temperature drops, the electrolyte contacts so that the specific gravity increases. Unless these variations in specific gravity are taken into account, the specific gravity obtained by the hydrometer may not give a true indication of the concentration of acid in the electrolyte.

Correction can be made for temperature by adding .004, usually referred to as 4 "points of gravity", to the hydrometer reading for every 10°F. that the electrolyte is above 80°F. or subtracting .004 for every 10°F. that electrolyte is below 80°F. Figure 10-4 shows the exact correction figure to use for any temperature above or below 80°F., the three steps used in obtaining the corrected or true specific gravity, and two examples showing how it is figured.

When using a hydrometer, observe the following points:

1. Hydrometer must be clean, inside and out, to insure an accurate reading.

2. Hydrometer readings must never be taken immediately after

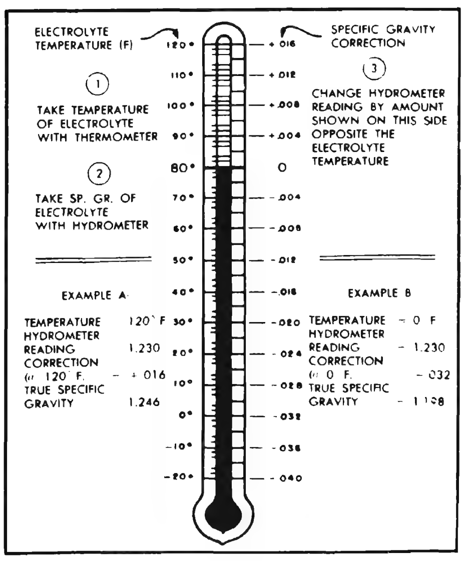


Figure 10-4—Specific Gravity Temperature Correction Scale

water has been added. The water must be thoroughly mixed with the electrolyte by charging for at least 30 minutes before hydrometer values are reliable.

3. If hydrometer has built-in thermometer, draw liquid into it several times to insure correct temperature before taking a reading.

4. Hold hydrometer vertically and draw in just enough liquid from battery cell so that float is free floating, and with bulb fully released. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard the curvation where the liquid rises against float stem due to surface tension.

5. Avoid dropping liquid on car or clothing as it is extremely corrosive. Any liquid that drops should be washed off immediately with soda solution.

10-11 TESTING AND CLEANING BATTERY AND CRANKING MOTOR CABLES

Whenever the battery is tested (par. 10-9) the battery and cranking motor cables should also be inspected for condition and tested for resistance. Resistance in the cables and connections causes voltage drop, and excessive voltage drop is liable to cause starting difficulties.

Carefully inspect the battery to junction block, battery to engine (ground) and cranking motor to junction block cables. If cable strands are broken, corroded, or loose in terminals the cable should be replaced with the correct cable to insure ample capacity.

Check terminals at both ends of each cable for tight connections. Since loose connections are usually dirty or corroded, any loose connections should be thoroughly cleaned before being tightened. If terminals are tight and cables are apparently in good condition, it is advisable to test them with a low-reading voltmeter to detect any abnormal internal resistance.

a. Testing Resistance of Cables and Terminal Connections

Battery cables and terminal connections may be tested with equipment comprising a voltmeter (5 volts maximum), ammeter of 300 or more amperes capacity, and carbonpile rheostat having a minimum capacity of 300 amperes connected in series with the ammeter.

1. Adjust rheostat to provide maximum resistance ("OFF" position).

2. Connect ammeter positive (+) lead to battery terminal stud on junction block. Connect ammeter negative (-) lead to one side of rheostat and connect other side of rheostat to ground on engine, preferably at point where battery ground strap is attached. In the instrument shown in Figure 10-5 the ammeter and rheostat are connected in series inside the case.

3. Connect voltmeter negative (-) lead to battery terminal stud on junction block. Use prod with voltmeter lead, if necessary, to insure direct contact with the terminal stud. Do not connect to the ammeter lead clip. Attach a prod to voltmeter positive (+) lead and apply the prod to center of battery positive (+) post (Figure 10-5). Make sure that clips of voltmeter leads have clean metal contact with prods.

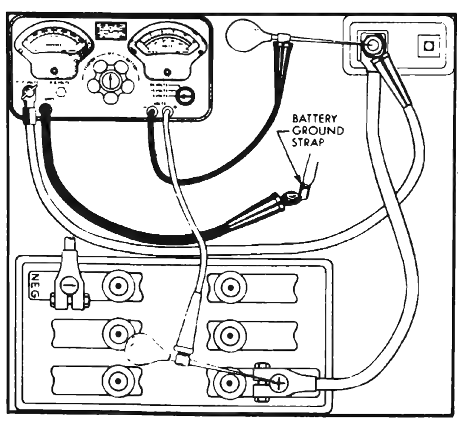


Figure 10-5—Battery Cable Test Connections

4. Adjust rheostat until ammeter reads 200 amperes, immediately read voltmeter, then turn rheostat to starting ("OFF") position to avoid excessive drain on battery. Voltage drop across battery positive cable and terminal connections should not exceed 2/10 volt.

5. Connect voltmeter positive (+) lead to ground on engine. Attach prod to voltmeter negative (-) lead and apply prod to center of battery negative (-) post. Voltage drop across the battery ground cable and terminal connections should not exceed 2/10 volt at 200 amps.

6. A reading in excess of 2/10 volt when testing either battery cable indicates excessive resistance in cable or connections. Clean and tighten cable or connections. Clean and tighten cable terminals (subpar. b, below) and recheck for voltage drop. If voltage drop still exceeds 2/10 volt replace cable with a genuine Buick cable to insure ample capacity.

7. If cranking is below normal speed, connect the ammeter positive (+) lead to the battery terminal stud on cranking motor solenoid switch, leaving the other lead attached to ground in engine.

8. Connect voltmeter negative (-) lead directly to battery terminal stud on solenoid switch. With prod of voltmeter positive (+) lead applied directly to battery terminal stud on junction block, repeat Step 4 above. The voltage drop across cranking motor cable and terminal connections should not exceed 2/10 volt at 200 amperes.

b. Cleaning Cable Terminals

If loose connections are found by inspection, or high resistance is found by voltage test, disconnect the cable for thorough cleaning of terminals. When removing a corroded cable terminal from battery post do not pry against battery case or hammer on terminal to break it loose, since either practice will result in broken cell covers. Use a screw type terminal puller if terminal cannot be loosened by hand after clamp bolt is fully loosened.

Thoroughly clean all corrosion from disconnected battery cable terminals and terminal posts, using suitable wire brushes. If wire brushes are not available, corroded terminals may be cleaned by brushing with a strong soda solution, using care not to get solution into battery cells.

To prevent corrosion of battery terminals and connections, apply a coating of petroleum jelly over the battery post and cable terminals after cables have been installed on terminals.

10-12 BATTERY RECHARGING

There are two separate methods of recharging batteries which differ basically in the rate of charge. In the slow-charge method, the battery is supplied a relatively small amount of current for an extended period of time. In the quick-charge method, the battery is supplied with a high current for a short period of time.

Figure 10-6—Using a Battery Terminal Puller

a. Slow-Charging

Slow charging is the best and only method of completely charging a battery. The slow-charge method, properly applied, may be safely used under all possible conditions of the battery, provided electrolyte is at proper level in all cells. The battery may be fully charged by this method, unless the battery is not capable of taking a full charge. The normal slow charging rate for the 12-volt battery is 5 amperes.

Full charge of battery is indicated when all cell specific gravities do not increase when checked at three intervals of one hour and all cells are gassing freely.

Due to the low rate during slow charging, plenty of time must be allowed. Charge periods of 24 hours or more are often required.

b. Quick-Charging

Since time is often of most importance to the battery owner, quick-charging must sometimes be used to partially charge the battery so that the engine will start and the owner can be on his way.

Charge at 50 amperes for 20 minutes (50 x 20 = 1000 ampere minutes). If charger will not give this rate, charge for an equal number of ampere minutes at the best rate available. For purposes of charging for the light load test, do not boost battery more than the amount indicated.

CAUTION: Too high a current during quick-charging will damage battery plates.

A battery cannot be brought up to a fully charged condition by the quick-charge method. The battery can be substantially recharged or boosted, but in order to bring the battery to a fully charged condition, the charging cycle must be finished by charging at a low or normal rate. Some quick-chargers have a provision for finishing the charging cycle at a low rate so that the battery can be brought up to a fully charged condition.

Used with care, and employing all safeguards provided by the manufacturer, a quick-charger will not damage a battery which is in good condition.

10-13 BATTERY AND CABLES—TROUBLE DIAGNOSIS

a. Quick Check of Battery and Cables

Whenever electrical trouble develops it is desirable to make a quick check of the battery and cables to make certain that this source of current is in good condition, securely connected, and is functioning properly. This check will also give a good check on the cranking system.

1. Turn on the lights. They should burn steadily and with normal brilliance.

2. With lights burning, operate the cranking motor. Either have the headlights shining on a wall so their brilliance can be noted, or have someone watching the headlights.

3. When cranking motor solenoid switch is closed, one of the following conditions will occur: (1) Lights will stay bright or will dim slightly if temperature is cold, and engine will be cranked at normal speed; (2) Lights will go out; (3) Lights will dim considerably; (4) Lights will stay

bright but no cranking action will take place. The first named condition indicates that nothing is wrong with the battery, cables, and cranking system. The other conditions indicate trouble as follows:

4. If lights go out as cranking motor solenoid switch is closed, it indicates a poor connection in the circuit between battery and cranking motor. Check battery cables and clean and tighten loose or corroded terminals (par. 10-11).

5. If lights dim considerably as cranking motor solenoid switch is closed, it indicates that the battery is run down, or there is a condition in cranking motor or engine which causes an excessive current drain on the battery. A low battery will be indicated by a clattering noise in cranking motor solenoid because the battery cannot sustain the voltage required to hold solenoid plunger "in" after switch contacts close and the "pull in" winding is shorted out.

Test battery with a light load test (par. 10-9). If battery is found to be in good condition check cranking motor (par. 10-28).

6. If lights stay bright but no cranking action occurs when cranking motor solenoid switch is closed, it indicates an open circuit in cranking motor, switch, or control circuit. See paragraph 10-28.

b. Undercharge Failure of Battery

The most frequent trouble experienced with storage batteries is failure to maintain a state of charge sufficient to crank the engine and also furnish current to the ignition system, lights and accessories. Failure to mainatin a proper state of charge may be due to one or more of the following conditions:

1. Operating Conditions. When determining cause of premature failure of a battery, consideration must be given to the conditions under which the car is operated.

In very low temperatures the capacity of a storage battery is considerably reduced and the energy required for cranking the engine is considerably increased.

Frequent starting, particularly in cold weather, accompanied by short runs may take more energy from the battery for cranking than the generator can replace in the limited running time. This condition is aggravated by night driving when lights are turned on, or by operation of an air conditioner in heavy traffic.

When the car is operated under these conditions, adjusting the voltage regulator to the high limit may allow enough increase to keep the battery at a safe state of charge. If the high limit setting does not maintain a safe state of charge an occasional booster charge should be given to the battery or an extra output generator obtained through dealer.

2. Low Charging Rate. In case of premature battery failure, the charging rate of generator should always be checked and adjusted if below specifications. See paragraph 10-21.

3. Internal Condition. The internal condition of the battery may be such that it cannot hold a charge satisfactorily. Check electrolyte level and light load test the battery (par. 10-11).

c. Overcharge Failure of Battery

A common cause of battery failure is overcharging, that is, continued input of excessive charging current after the battery has reached a fully charged condition.

One evidence that battery is being overcharged is the need for frequent addition of water to the battery in order to maintain the electrolyte level above the tops of the battery separators, since overcharging causes rapid water loss. When this becomes evident the charging rate of generator should be immediately checked and adjusted (par. 10-21) to avoid internal damage to battery.

SECTION 10-C
GENERATING SYSTEM

CONTENTS OF SECTION 10-C

10-14 DESCRIPTION OF DELCOTRON GENERATOR

"Delcotron"* generators are continuous-output, diode-rectified alternating current generators. See Figure 10-7. The rotor is mounted on a ball bearing at the drive end, and a roller bearing at the slip ring end, and each bearing has a grease supply which eliminates the need for periodic lubrication. Two brushes are used to carry current through the two slip rings to the field coil which is mounted on the rotor. The brushes are extra long and under normal operating conditions will provide long periods of service.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. See Figure 10-8.

*General Motors Trademark

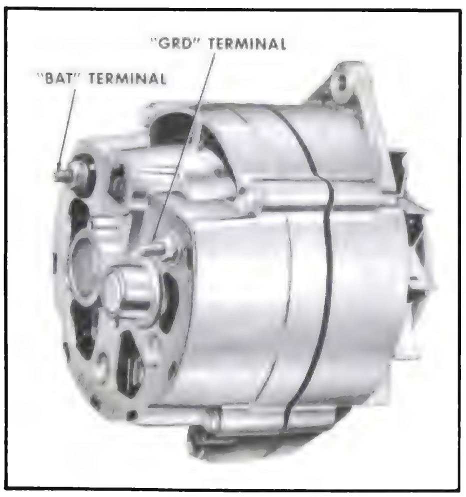


Figure 10-7—Delcotron Generator

Six rectifier diodes are mounted in the slip ring end frame and are connected to the stator windings. The six diodes act to change the generator AC voltages to DC voltage which appears at the "BAT" terminal of the generator.

IMPORTANT: Since the generator and regulator are designed for use on only one polarity system (negative ground), the following precautions must be observed when working on the charging circuit. Failure to observe these precautions will result in serious damage to the electrical equipment.

1. When installing a battery, always make absolutely sure the negative post is toward ground.

2. When connecting a booster battery make certain to connect the negative battery terminals together and the positive battery terminals together.

3. When connecting a charger to the battery, connect the charger positive lead to the battery positive terminal and the charger negative lead to the battery negative terminal.

4. Never operate the generator on open circuit. Make absolutely certain all connections in the circuit are secure.

5. Do not short across or ground any of the terminals on the generator or regulator.

6. Do not attempt to polarize the Delcotron generator.

10-15 GENERATOR REPAIR—ON BENCH

a. Disassembly

To disassemble the generator, take out the four thru-bolts, and separate the drive end frame and rotor assembly from the stator assembly by prying apart with a screwdriver at the stator slot. See Figure 10-8. A scribe mark will help locate the parts in the same position during assembly. The fit between stator and frame is not tight, and the two can be separated easily. Note that the separation is to be made between the stator frame and drive end frame. After disassembly, place a piece of tape over the slip ring end frame bearing to prevent entry of dirt and other foreign material.

To remove the drive end frame from the rotor, place the rotor in a vise and tighten only enough to permit removal of the shaft nut.

CAUTION: Avoid excessive tightening as this may cause distortion of the rotor. Remove the shaft nut, washer pulley, fan and the collar, and then separate the drive end frame from the rotor shaft.

If the rotor shaft has a hex socket in the drive end, use a 5/16" Allen wrench to hold the shaft during removal of the shaft nut.

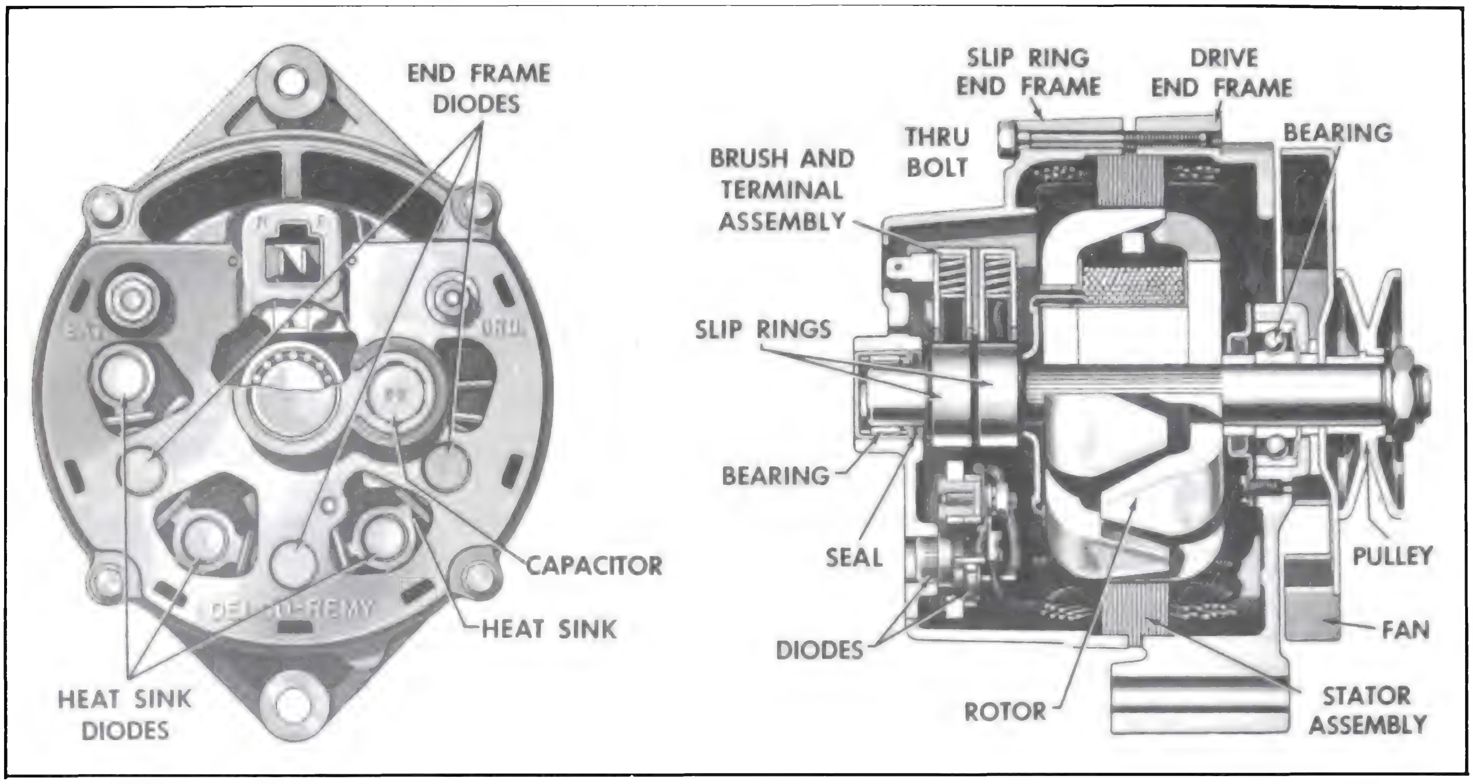


Figure 10-8—Sectional View

b. Rotor Checks

The rotor may be checked electrically for grounded, open or short circuited field coils. To check for grounds, connect a test lamp from either slip ring to the rotor shaft. See Figure 10-9. If the lamp lights, the field winding is grounded.

To check for opens, connect the test lamp to each slip ring. If the lamp fails to light, the winding is open.

The field winding is checked for short-circuits by connecting a battery and ammeter in series with the two slip rings. The field current at 12 volts and 80°F. should be between 1.9 and 2.3 amperes. (2.1 to 2.5 amperes with air conditioner). An ammeter reading above the specified value indicates shorted windings.

If the rotor is not defective but the generator failed to supply rated output, the trouble is in the stator or rectifying diodes.

c. Stator Checks

To check the stator windings, remove all three stator lead attaching nuts, and then separate the stator assembly from the end frame. The fit between stator frame and end frame is not tight, and the two can be separated easily.

The stator winding may be checked with a test lamp. If the lamp lights when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light when successively connected between each pair of stator leads, the windings are open. See Figure 10-10.

A short circuit in the stator windings is difficult to locate without laboratory test equipment due to

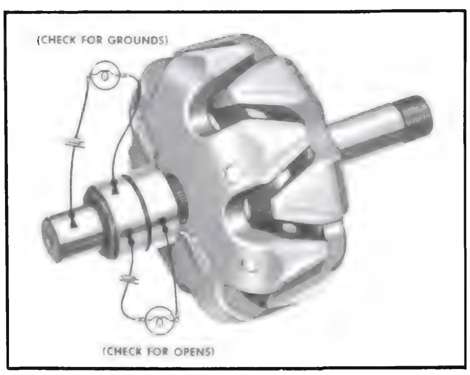


Figure 10-9—Checking Rotor for Opens or Grounds

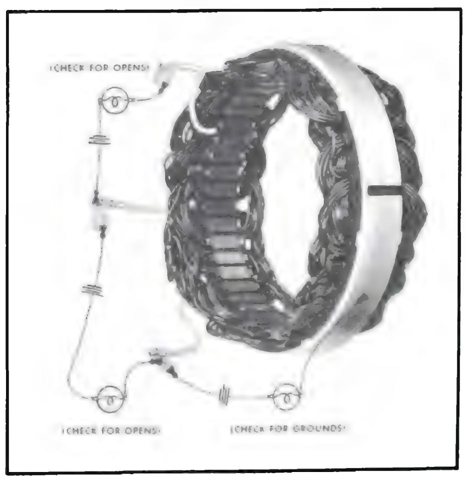


Figure 10-10—Checking Stator for Opens or Grounds

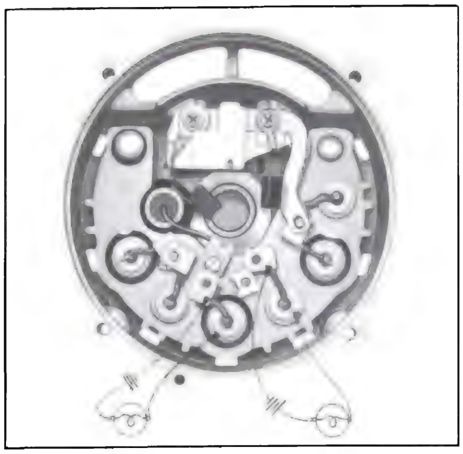


Figure 10-11—Checking Diodes for Opens or Shorts

the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated.

d. Diode Checks

Each diode should be checked electrically for a shorted or open condition using a test lamp of not more than 12 volts. CAUTION: Do not use a 110-volt test lamp to check diodes.

With the stator disconnected, connect the test lamp leads across each diode, first in one direction and then in the other. See Figure 10-11. If the lamp lights in both checks, or fails to light in both checks, the diode is defective. When checking a good diode, the lamp will light in only one of the two directions.

e. Diode Replacement

1. To remove a diode, place slip ring end frame in a vise so that Remover J-9717-1 bears against defective diode and Support J-9717-2 supports casting. Tighten vise to remove defective diode. See Figure 10-12.

2. To install a diode, place new diode in Installer J-9600-2. Place slip ring end frame in a vise so that new diode is in position and Remover J-9717-1 supports casting. See Figure 10-13. Tighten vise to install new diode. CAUTION: Never attempt to remove or install a diode by striking it, as the shock may damage the other diodes.

f. Slip Ring Servicing

If the slip rings are dirty, they may be cleaned with No. 400 silicon carbide paper and finish polished with crocus cloth. Spin the rotor in a lathe, or otherwise spin the rotor, and hold the polishing cloth against the slip rings until they are clean. CAUTION: The rotor must be rotated in order that the slip rings will be cleaned evenly. Cleaning the slip rings by hand without spinning the rotor may result in flat spots on the slip rings, causing brush noise.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish polish with crocus cloth and blow away all dust.

g. Bearing Replacement

The bearing in the drive end frame can be removed by detaching the retainer plate screws, and then pressing the bearing from

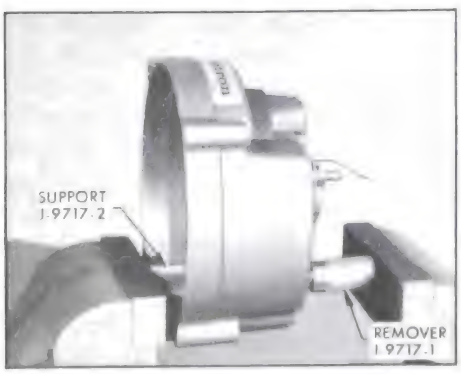


Figure 10-12—Removing a Diode

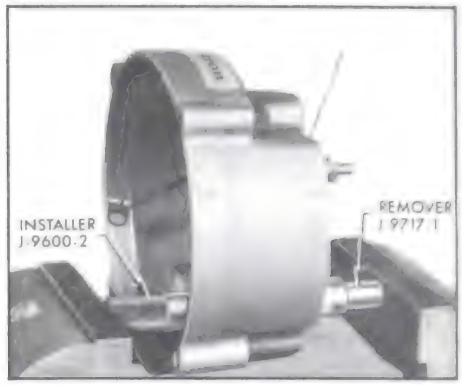


Figure 10-13—Installing a Diode

the end frame with Support J-9717-2.

To install a new bearing, press in with a tube or collar that just fits over the outer race. It is recommended that a new retainer plate be installed if the felt seal in the retainer plate is hardened or excessively worn.

The bearing in the slip ring end frame can be removed by pressing with a tube or collar that just fits inside the end frame housing. Press from the outside of the housing towards the inside using Support J-9717-2.

To install a new bearing, place a flat plate over the bearing and press in from the outside towards the inside of the frame until the bearing is flush with the outside of the end frame. Support the inside of the frame with a hollow cylinder to prevent breakage of the end frame. Use extreme care to avoid misalignment or otherwise placing undue stress on the bearing.

Saturate the felt seal with SAE 20 oil, and then reassemble the felt seal and steel retainer.

The bearings in the generator are permanently lubricated and require no lubrication during the life of the bearings. If a dry bearing is encountered, do not attempt to lubricate the bearing as improper lubricant or an

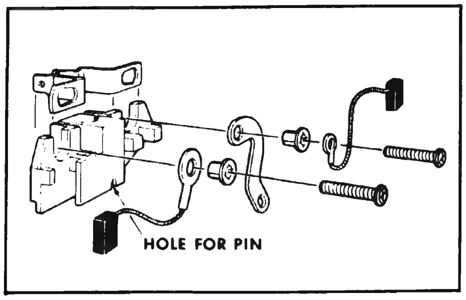


Figure 10-14—Assembling Brush Holder and Parts

excessive amount of lubricant may be thrown off and contaminate the inside of the Delcotron. Replace a dry, worn, or rough bearing with a new bearing which will be prepacked with the proper kind and amount of lubricant.

h. Brush Replacement

When the slip ring end frame assembly is separated from the rotor and drive end frame assembly, the brushes will fall down onto the shaft and come in contact with the lubricant. If the brushes are to be re-used, they must be thoroughly cleaned with a soft dry cloth. Also, the shaft must be thoroughly cleaned before reassembly.

The brush springs should be inspected for any evidence of damage or corrosion. If there is any doubt as to the condition of the brush springs, they should be replaced.

To install new brushes, remove the brush holder assembly from the end frame by detaching the two brush holder assembly screws. Install the springs and brushes into the brush holder, and insert a straight wire or pin into the holes at the bottom of the holder to retain the brushes. Then attach the brush holder assembly onto the end frame, noting carefully the proper stack-up of parts as shown in Figure 10-14. Allow the straight wire to protrude through the hole in the end frame.

i. Heat Sink Replacement

The heat sink may be replaced by removing the "BAT" and "GRD" terminals from the end frame, and the screw attaching the condenser lead to the heat sink. During reassembly, note carefully the proper stack-up of parts as shown in Figure 10-15.

j. Reassembly

Reassembly is the reverse of disassembly. See Figure 10-16 for connection of internal leads. Remember when assembling the pulley to secure the rotor in a vise only tight enough to permit tightening the shaft nut to 50-60 ft. lbs. If excessive pressure is applied against the rotor, the assembly may become distorted.

To install the slip ring end frame assembly to the rotor and drive end frame assembly, remove the tape over the bearing and shaft, and make sure the shaft is perfectly clean.

Insert a straight wire as previously mentioned through the holes in the brush holder and end frame to retain the brushes in the holder. Then withdraw the wire after the generator has been completely assembled. The brushes will then drop onto the slip rings.

10-16 DESCRIPTION OF REGULATOR

The regulator assembly is made up of a double contact voltage regulator unit and a field relay. See Figure 10-17. The voltage regulator unit operates to limit the generator voltage to a preset

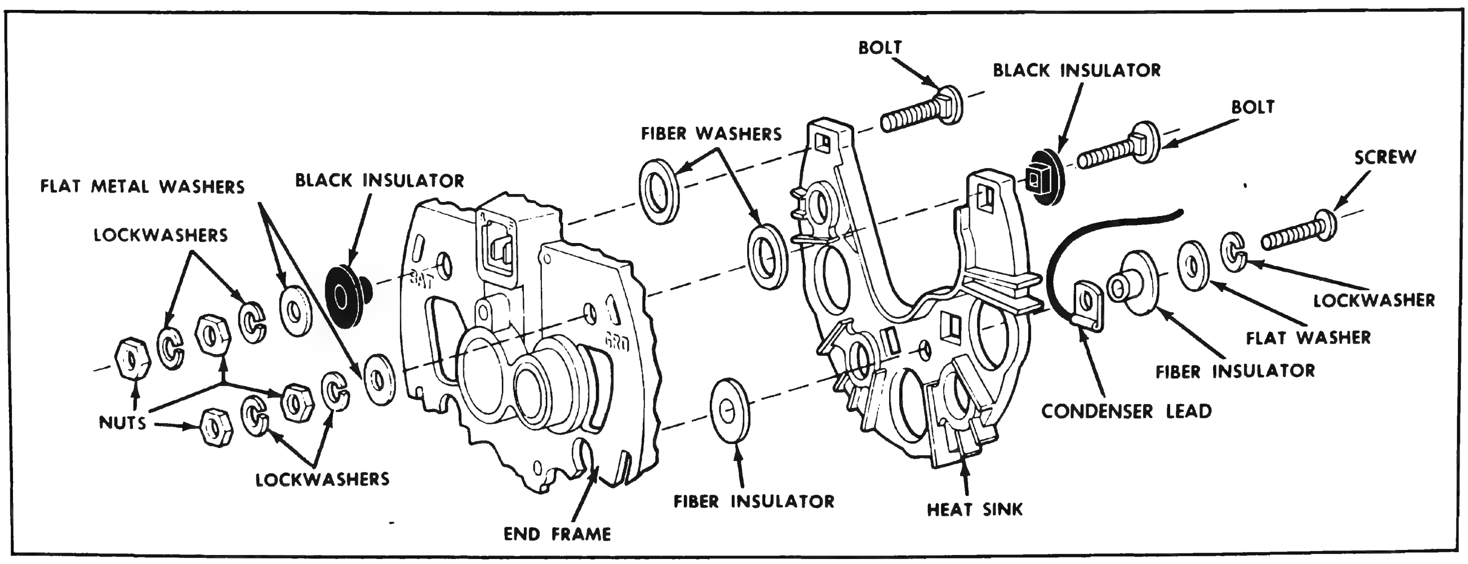


Figure 10-15—Assembling Heat Sink and Parts

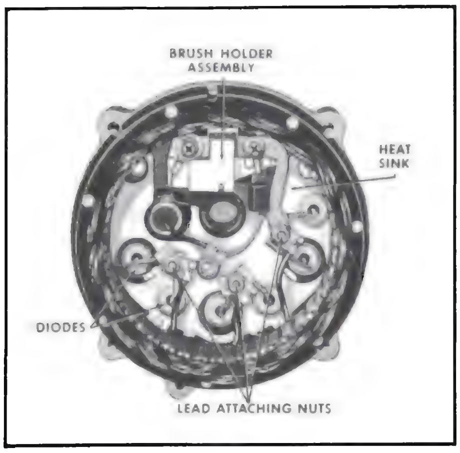


Figure 10-16—Internal Leads

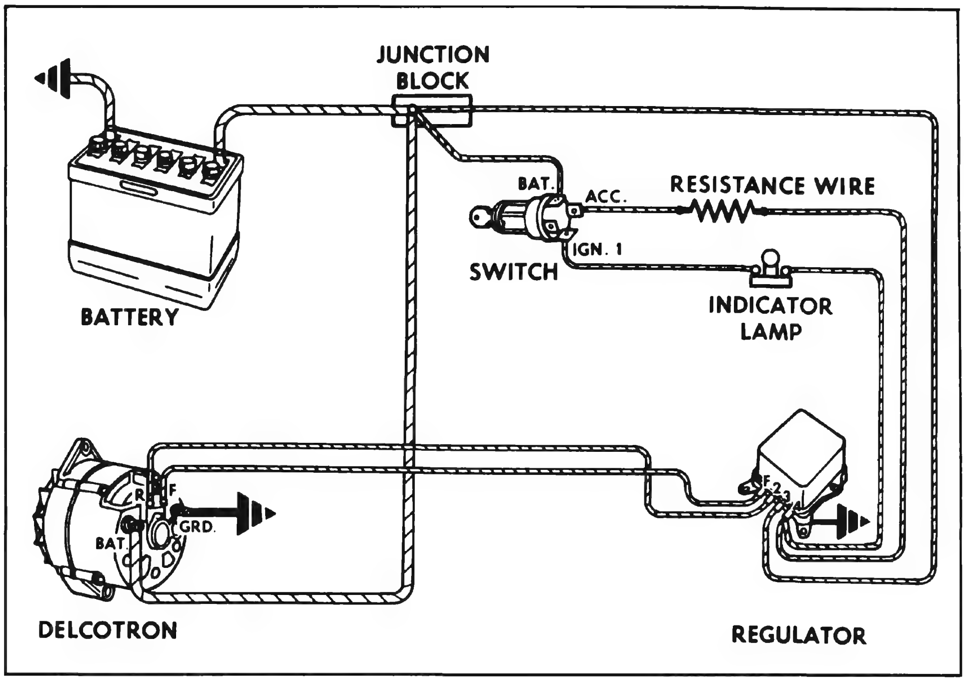


Figure 10-18—Delcotron Generator Wiring

maximum. The field relay connects and disconnects the voltage regulator and generator field directly to the battery. The indicator lamp lights at about 1/2 brightness when the ignition switch is turned on; when the engine is started, the indicator light goes out. If the indicator light ever comes on with the engine running, trouble in the charging system is indicated.

10-17 OPERATION OF CHARGING SYSTEM

Before the generator will put out any current, the rotor field must be energized. The rotor poles have practically no residual magnetism, so unless current is supplied to the field from the battery, there can be no output from the generator.

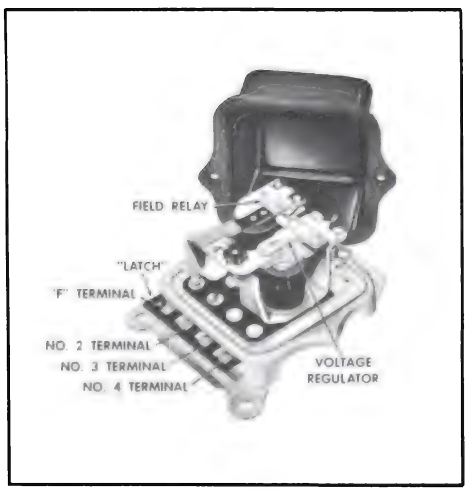


Figure 10-17—Regulator

When the ignition switch is turned on, current flows immediately through the field to ground inside the generator. Before the engine is started, the path of the field current is from the junction block, to the "BAT" terminal of the ignition switch, through the switch to both the "IGN" and the "ACC" terminal. From the "IGN" terminal, current flows through the generator indicator light in the instrument cluster (causing it to light), to the "4" terminal of the regulator. See Figure 10-22.

The indicator light circuit allows only about 1/4 ampere to flow, which is not sufficient to initially energize the field. Therefore, a parallel circuit is necessary; this circuit allows about 3/4 ampere to flow from the "ACC" terminal, through the large cowl connector, through a 10 ohm resistance wire to the "4" terminal of the regulator. The combined current of about one ampere flows through the lower contacts of the voltage regulator (held closed by the spring), out the "F" terminal of the regulator, in the "F" terminal of the generator, through the brush and slip ring to ground. See Figure 10-19.

When the engine is started, the stator windings immediately put-out a voltage. This voltage is conducted from one phase of the stator, out the "R" terminal of the generator, in the "2" terminal of the regulator, through the field relay windings to ground. Even a low voltage at the field relay is sufficient to overcome the spring tension of the armature, thereby closing the field relay contacts.

The instant the field relay closes, the field current is supplied directly from the battery instead of through the ignition switch and resistance wire. The field current then comes from the battery, into the "3" terminal of the regulator through the field relay, and on through the field as before. This allows the same voltage to be present at the "4" terminal as at the ignition switch, thereby causing current to stop

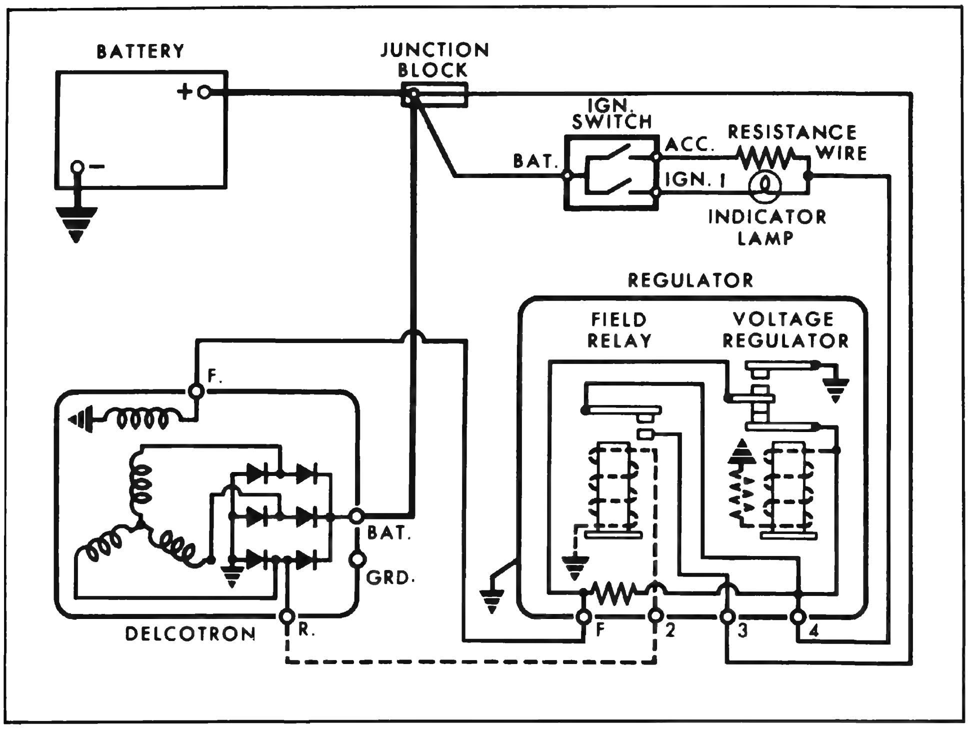


Figure 10-19—Delcotron Generator Wiring Circuit Diagram

flowing through either connecting wire and causing the generator indicator light to go out. The field relay, therefore, has a dual function; it not only completes the circuit between the battery and the field, but also acts as an indicator light relay.

The voltage regulator armature has two contact points which are over and under stationary contact points. When the voltage regulator unit is not operating, the tension of a spiral spring holds the armature away from the core so that the lower set of contacts is closed. See Figure 10-19.

Generator output depends on two variables: Speed and field strength. Only the field strength can be controlled, however. Voltage regulator operation varies according to operating conditions of the car electrical system. There are several stages of voltage regulator operation as follows:

a. Lower Contacts Closed

When the accessories and/or battery need a great deal of current, but the engine speed is low, the lower contacts will remain tightly closed to allow full field current of approximately 2 amperes. The accessory load not supplied from the generator will be supplied from the battery.

b. Lower Contacts Vibrating

When the accessory load or battery needs are somewhat less, or the engine speed is a little higher, 2 amperes field current would cause too much generator output. Therefore, the lower voltage regulator contact will vibrate to reduce field current. When the contacts are open, the entire field current must flow through the resistor, which limits current to about 3/4 ampere. While the lower contacts are vibrating, then, field current will be somewhere between 2 amperes and 3/4 ampere, depending on the rate of vibration.

c. Both Contacts Open

When the balance of the accessory load and the engine speed is such that approximately 3/4 ampere field current will provide exactly the needed generator output, the voltage regulator armature will "float" with neither set of contacts touching. Any change in speed or load will upset the balance, however, causing the regulator contacts to again vibrate.

d. Upper Contacts Vibrating

When the combined accessory and battery load is low and the engine speed is high, very little field current is required to provide the needed generator output. The voltage in the charging circuit will rise between .1 and .3 volt and the regulator armature will be drawn farther down to operate on the upper set of contacts. When the contacts are open, field current will be about 3/4 ampere; when the contacts are closed, the upper armature grounds the current from the resistor and field current is zero. See Figure 10-19. While the upper contacts are vibrating, then, field current will be somewhere between 3/4 ampere and zero, depending on the rate of vibration.

The regulator does not contain a cutout relay unit. The rectifier diodes act as one-way check valves to prevent the battery from discharging back through the generator, thereby making a cutout relay unnecessary.

The regulator does not contain a current limiting unit because an alternating current generator acts as its own current regulator.

10-18 TROUBLE-SHOOTING CHARGING SYSTEM

SPECIAL PRECAUTIONS: Alternating current charging system circuits are completely different

from direct current charging system circuits. Therefore, none of the troubleshooting checks used for direct current systems can be used. The diodes may be burned out if you do not observe the following precautions:

1. Never arc terminals. Never short between terminals on the generator or regulator; never arc any terminal to ground. The field has no residual magnetism and therefore cannot be polarized; any attempt to do so may cause damage.

2. Always observe polarity. Use extreme caution before installing a battery, connecting a fast charger or connecting a booster battery to insure that the ground polarity is matched to the ground polarity of the generator and regulator. For example, if a battery is accidentally installed in reverse, the diodes in the generator may be burned out and the wiring harness between the generator and battery will be burned. The generator charging system is a negative ground system, just as Buick's charging systems have always been.

3. Always disconnect battery before doing any work on the generator or regulator.

Complaints on operation of the charging system generally fall into one of the following classifications. Go through steps listing possible troubles in order until the trouble is found.

a. Battery Runs Down

1. Check generator belt tension. Belt tension as measured with Gauge J-7316 should be 80 pounds with a single belt or 110 pounds with a double belt.

2. Check battery condition. Light load test battery to see if battery is actually low (par. 10-9). If low, quick-charge battery and retest to see if battery is defective. A battery which is sulphated or one with an intermittent internal "open" will remain in an undercharged condition. Replace a defective battery.

3. Check for short or ground. To check complete car electrical system for a short or ground, disconnect ground cable from battery and connect a voltmeter between ground cable and battery post. Make sure all lights and accessories are off and that clock is wound. If voltmeter reads battery voltage, there is a short or ground which must be traced and eliminated; any reading less than battery voltage indicates current leakage so slight that nothing need be done about it.

4. Check generator output. Hookup test instruments and check current output of generator as described in Delcotron Generator Tests paragraph. If output is low, remove generator for disassembly, test and repair. If generator output tests okay, leave test instruments hooked up and proceed with Step 5.

5. Check voltage regulator setting, as described in Delcotron Generator Tests paragraph. If voltage fluctuates, look for loose or corroded connections in the charging system; if none, clean voltage contacts as described in paragraph on Cleaning Regulator Contacts. If voltage setting is low, adjust to specifications shown in Figure 10-21.

If voltage setting is within the specified limits, but battery checked low in Step 2, raise voltage setting slightly as described in paragraph on Tailoring The Voltage Setting.

b. Battery Uses Too Much Water

1. Check battery condition. Light load test battery to see if there is a shorted cell (par. 10-9). A battery having a shorted cell will use water excessively. Replace a defective battery.

2. Check voltage regulator setting, as described in Delcotron Tests paragraph. If voltage setting is high, adjust to specifications shown in Figure 10-21. If voltage setting is within limits, lower voltage setting slightly as described in paragraph on Tailoring Voltage Setting.

c. Faulty Indicator Light Operation

There are three conditions of indicator light operation which indicate trouble in the charging system.

1. Indicator light on - ignition off. This is caused by a shorted positive diode. There will be a continuous drain on the battery through the generator. Remove generator for disassembly, test and repair.

2. Indicator light off - ignition on. Before the engine is started, the indicator light should glow at about 1/2 the brightness of the oil pressure light. If the light does not come on, check for either a burned out bulb or an open in the indicator light circuit. A shorted diode as described in Step 1 will also cause the indicator light to go off when the ignition is switched on.

3. Indicator light on - engine running. This can be caused by a loose or missing belt, a defective field relay, or a defective generator. Determine source of trouble as follows:

(a) Check generator belt tension.

(b) Check voltage at field relay coil by connecting a voltmeter from regulator "2" terminal to ground. If voltmeter reading is above 5 volts and the indicator light fails to go out, field relay is defective. Check and replace,

if necessary. If voltmeter reading is below 5 volts, field relay is probably okay so proceed with Step c.

(c) Check voltage at generator field by connecting a voltmeter from generator "F" terminal to ground. If voltmeter reading is below 5 volts, check for a resistance or open in the circuit that should supply the initial field current. See Figure 10-23.

If voltmeter reading at "F" terminal is above 5 volts but voltage output from "R" terminal is low, trouble is in the generator. Hookup test instruments and check current output of generator as described in Delcotron Generator Tests paragraph. If output is low, remove generator for disassembly, test and repair.

10-19 INSPECTING CHARGING SYSTEM

At regular intervals, inspect the terminals for corrosion and loose connections, and the wiring for frayed insulation. Check the mounting bolts for tightness and the belt for alignment, proper tension and wear. Belt tension should be adjusted to 80 pounds with a single belt or 110 pounds with a double belt as measured with Gauge J-7316. When tightening belt tension, apply pressure against the stator laminations between the end frames, and not against either end frame.

Noise from a Delcotron generator may be caused by worn or dirty bearings, loose mounting bolts, a loose drive pulley, a defective diode, or a defective stator.

10-20 CLEANING REGULATOR CONTACTS

The voltage regulator contacts should not be cleaned unless the electrical performance indicates it is necessary. A sooty or discolored condition of the contacts is normal after a relatively short period of operation and is not an indication that cleaning is necessary. However, if the voltage fluctuates as evidenced by an unsteady voltmeter reading when checking the voltage setting, the contacts may have excessive resistance or be sticking and they, therefore, should be cleaned.

CAUTION: Before cleaning contacts, make sure the unsteady voltage is not being caused by loose connections or high resistance elsewhere in the system.

The contacts on the voltage regulator unit are of a soft material and must not be cleaned with a file. A strip of No. 400 silicon carbide paper or equivalent folded over and then pulled back and forth between the contacts is recommended as a satisfactory method of cleaning. After cleaning, the contacts should be washed with trichlorethylene or alcohol to remove any residue. If the voltage control has not improved, repeat the cleaning and washing process.

To clean the field relay contacts, use a thin fine-cut, flat file. Remove only enough material to clean the points. CAUTION: Never use emery cloth or sandpaper to clean contact points.

10-21 DELCOTRON GENERATOR TESTS

a. Test Current Output

1. Check belt tension. Adjust to 80 lbs. with a single belt or 110 lbs. with a double belt as measured with Gauge J-7316.

2. Disconnect ground cable from battery.

3. Connect ammeter between generator "BAT" terminal and disconnected lead as shown in Figure 10-20.

4. Connect a tachometer from distributor terminal of coil to ground.

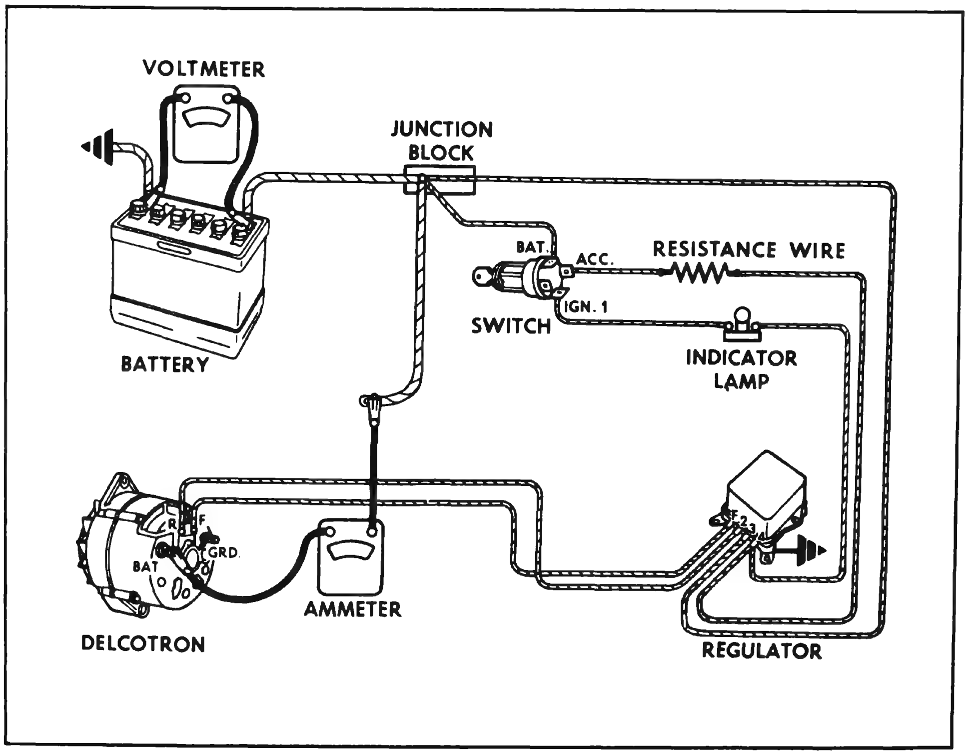


Figure 10-20—Delcotron Generator Tests

Air Temperature at Regulator	85°	105°	125°	145°	165°
Voltage Setting	13.8-14.6	13.7-14.5	13.5-14.3	13.4-14.2	13.2-14.0

Figure 10-21—Voltage Regulator Settings

5. Reconnect battery ground cable. Connect a voltmeter across battery.

6. Turn on all possible accessory load. Apply parking brake firmly. Start engine. Adjust engine idle to exactly 500 RPM in Drive. At this engine speed, generator output should be 10 amperes or over. Shift transmission to Park. Increase engine speed to exactly 1500 RPM; output should be 30 amperes or over. Shut off engine. Turn off all accessories.

7. If output is low in either of the above tests, try supplying field directly to cause full generator output. Unplug connector from generator. Connect a jumper such as Adaptor J-21053 from generator "F" terminal to "BAT" terminal. Retest as described in Step 6. If output is still low, generator is faulty and must be removed for bench tests and repairs.

8. If output (using field jumper) is now okay, trouble is in the regulator or wiring harness. Clean and test regulator. Check all wiring connections.

9. Remove field jumper and reinstall vehicle field connector.

b. Test and Adjust Voltage Regulator Setting

1. Test current output as described above. See Figure 10-20. Leave all test instruments in place, but make sure field jumper is removed, if used.

2. Install a thermometer such as Gauge J-8529 near regulator.

3. Run engine at approximately 1500 RPM for 15 minutes. Make sure all electrical load except ignition is turned off.

4. Check ammeter reading. For an accurate voltage setting check, ammeter must read between 3 and 10 amperes. (If ammeter reading is still high after 15 minutes, it may be necessary to substitute a fully charged battery.) Momentarily increase engine speed to approximately 2000 RPM and read voltmeter and thermometer. See Figure 10-21 to determine if upper voltage regulator setting is within limits for the existing temperature. If setting is within limits and battery condition has been satisfactory, voltage setting should not be disturbed.

5. If voltage regulator setting is out of limits, make a note of change required to put voltage in middle of specified range. Remove regulator cover, lifting cover carefully straight up. CAUTION: If the cover touches either regulator unit, the resulting arc may ruin the regulator assembly.

6. With cover off, voltage reading will change considerably. Starting with the changed voltage reading, increase or decrease voltage (the amount determined in Step 5) as shown in Figure 10-22.

CAUTION: Always make final adjustment by increasing spring tension to assure contact between screw head and spring support.

Figure 10-22—Adjusting Voltage Regulator Setting

7. After making an adjustment, replace cover carefully and recheck voltage setting of regulator.

10-22 TAILORING THE VOLTAGE SETTING

It is important to remember that the voltage setting for one type of operating condition may not be satisfactory for a different type of operating condition. Vehicle underhood temperatures, operating speeds, and nighttime service all are factors which help determine the proper voltage setting. The proper setting is attained when the battery remains fully charged with a minimum use of water.

If not circuit defects are found, yet the battery is continually undercharged, raise the setting by .3 volt, and then check for an improved battery condition over a service period of reasonable length. If the battery is continually overcharged, lower the setting by .3 volt, and then check for an improved battery condition. However, never adjust the voltage setting out of the limits specified in Figure 10-21.

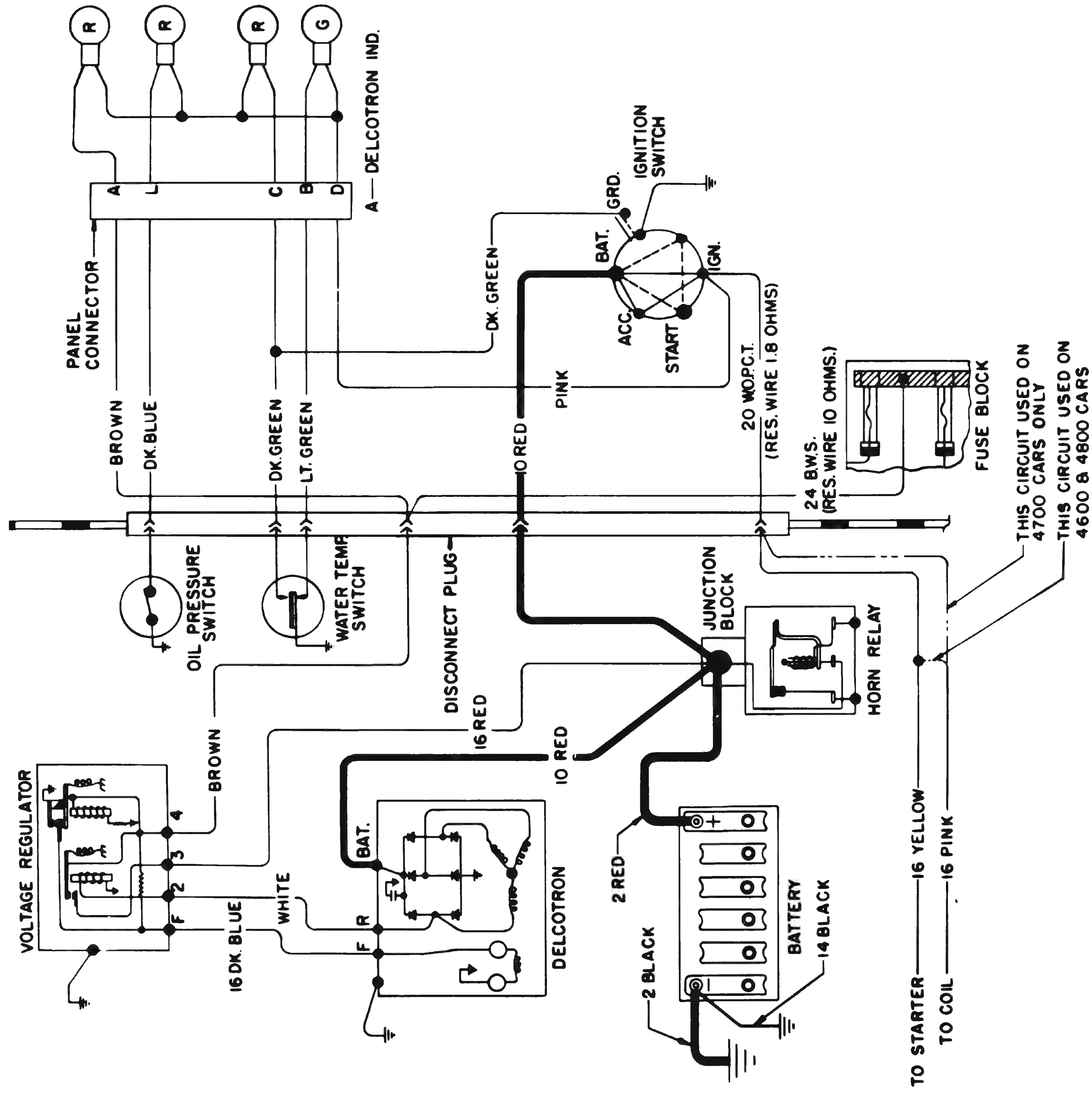


Figure 10-23—Delcotron Generator Wiring Diagram

SECTION 10-D
CRANKING (STARTER) SYSTEM

CONTENTS OF SECTION 10-D

10-23 DESCRIPTION OF CRANKING SYSTEM

In the Buick cranking system, the engine is cranked by turning the ignition switch to the extreme clockwise position marked "START". The "START" position is spring loaded in such a way that the switch returns to the "ON" position when released.

The cranking system, shown schematically in Figure 10-24, is composed of the following units:

1. Battery and battery cables (par. 10-11).

2. Cranking motor, including the drive assembly which engages the flywheel ring gear during cranking operation (par. 10-25).

3. Cranking motor solenoid switch, mounted on the cranking motor, for shifting the drive assembly and closing the motor circuit (par. 10-25).

4. Ignition switch, which when in the "START" position connects a lead from the battery to the solenoid switch, passing through the neutral safety switch on the way. During cranking the ignition switch also connects the battery directly to the ignition coil, thereby by-passing the resistance wire which normally supplies the ignition coil at a lower voltage.

5. Neutral safety switch (automatic transmission cars only). This switch is connected between the ignition switch and the solenoid switch to prevent cranking of the engine except when the transmission control lever is in either neutral (N) or park (P) position.

10-24 OPERATION OF CRANKING SYSTEM

When the ignition switch is turned fully clockwise to the "START" position, a connection is made from the battery terminal of the ignition switch to the solenoid terminal of the switch. From here, a large wire carries the current to a terminal on the solenoid switch of the cranking motor. A neutral safety switch is located in series in this wire. The transmission control lever must be in neutral (N) or park (P) position so that the neutral safety switch is also closed.

Closing of the ignition "START" switch and the neutral safety switch permits battery current to flow through the "pull-in" and "hold-in" coils of the solenoid, magnetizing the solenoid. The plunger is pulled into the solenoid so that it operates the shift lever to move the drive pinion into engagement with the flywheel ring gear. The solenoid switch contacts then closes after the drive pinion is partially engaged with the ring gear; this prevents any possible gear clash. See Figure 10-24.

The closing of the solenoid switch contacts causes the motor to crank the engine and also cuts out the "pull-in" coil of the solenoid, the magnetic pull of the "hold-in" being sufficient to hold the pinion in mesh after the shifting has been performed. This reduces the current consumed by the solenoid while the cranking motor is operating. See Figure 10-24.

As soon as the engine starts running, the overrunning clutch starts free-wheeling. This allows the starter pinion to be driven by the flywheel ring gear without causing the armature speed to increase greatly. (Because of the large gear ratio between the pinion and the ring gear, a seized overrunning clutch will cause the armature to be driven at an excessive speed which may cause the armature windings to be thrown). As soon as the driver realizes that the engine has started, he releases the ignition key and a spring in the ignition switch returns it to the "ON" position. This breaks the solenoid circuit so that the solenoid is demagnetized. A return spring then actuates the shift lever to retract the solenoid plunger, which permits another spring to open the solenoid switch contacts. The

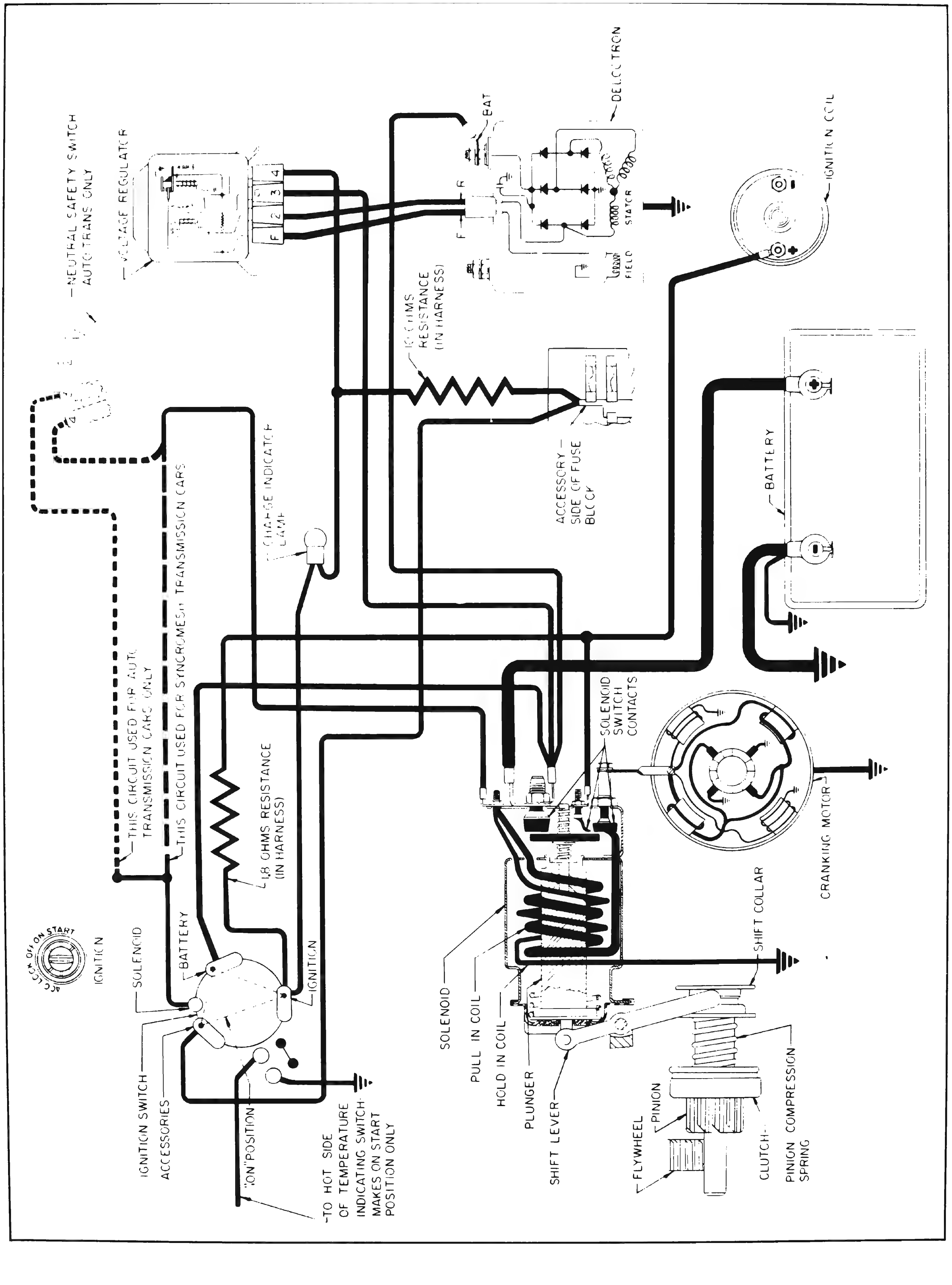


Figure 10-24—Starter and Generator Circuit Diagram - 4400 Series

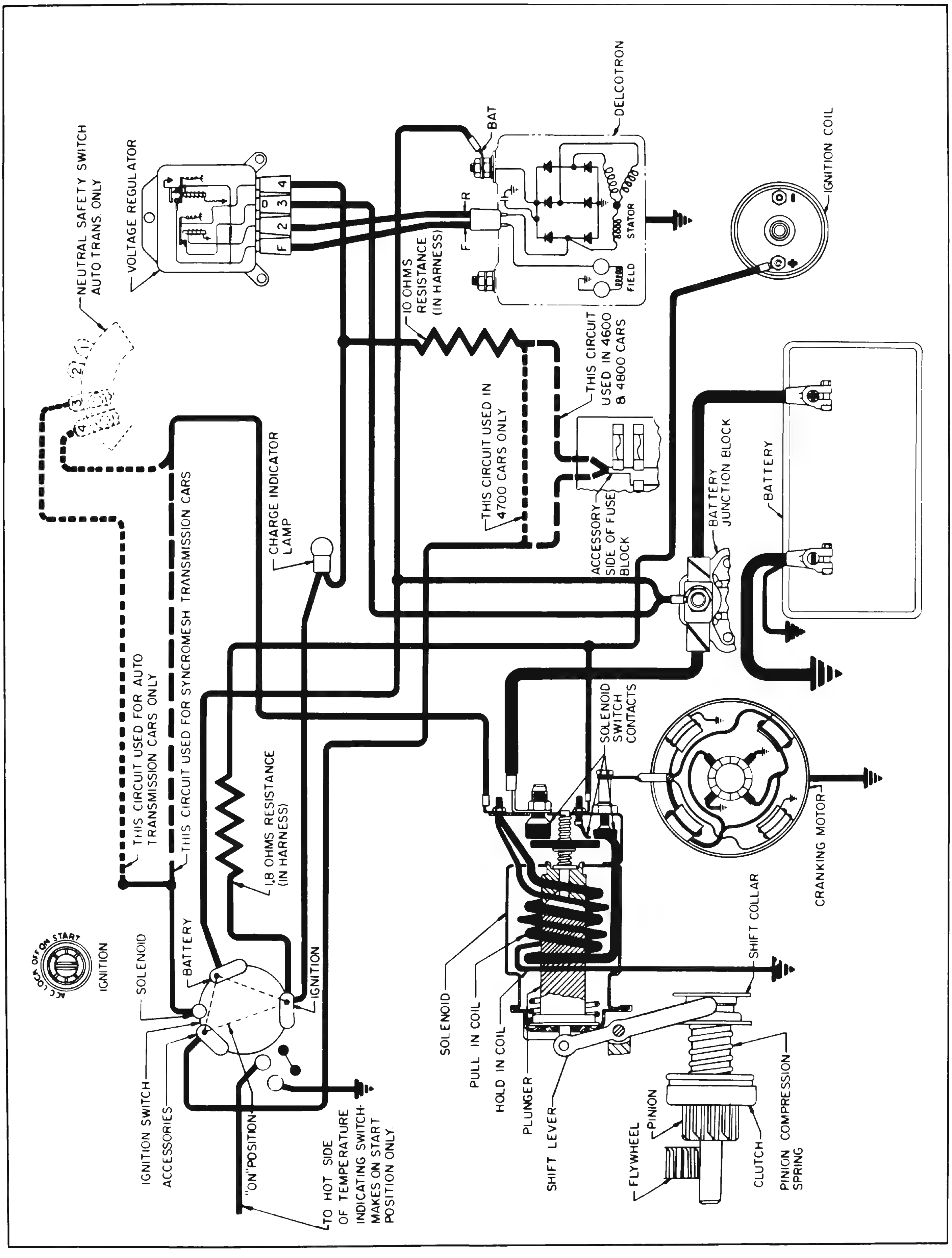


Figure 10-25—Starter and Generator Circuit Diagram -46-47-4800 Series

shift lever then disengages the drive pinion from the flywheel ring gear. After the transmission is shifted out of park or neutral, the neutral safety switch will prevent accidental engagement of the drive pinion with the flywheel.

10-25 CRANKING MOTOR AND SOLENOID SWITCH

The cranking motor assembly consists of a motor, drive assembly, shift lever, and solenoid switch. See Figure 10-26.

a. Cranking Motor, Drive and Shift Lever

The cranking motor is an enclosed shift lever type, having an extruded frame, four poles and a compound field. The drive end housing is extended to enclose the entire shift lever mechanism and plunger to protect them from road dirt, icing conditions, and splash. The solenoid is flange mounted onto the drive end housing and is sealed to the drive housing by a sealing compound. The shift lever return spring is a compression type and is located inside the solenoid case. A rubber grommet assembled in the frame around the field lead insulates it from grounding and also prevents dirt, water, and oil from entering the motor.

The armature shaft is supported at both ends in graphite bronze bushings pressed into the commutator end frame and the drive housing. Neither of these bearings require lubrication except during assembly. See Figure 10-26.

The four brushes are supported by brush holders mounted on the field frame. Two opposing brushes are connected to the field coils. The field coils are held in place by the pole shoes which are attached to the field by large screws. The field coils are connected to an insulated connecting link in the field frame, through which current is supplied to the motor.

The drive assembly is mounted on the motor armature shaft and keyed to it by helical splines so that it can be moved endwise on the shaft by the solenoid operated shift lever. It transmits cranking torque to the flywheel ring gear, but its overrunning clutch allows the drive pinion to rotate freely with reference to the armature shaft when the engine begins to operate, thus preventing the armature from being driven at excessive speed by the engine.

The drive assembly pinion is moved into engagement with flywheel ring gear by action of the solenoid upon the shift lever, which engages the shift collar of drive assembly. The shift collar moves the drive assembly by pushing on the clutch spring, which serves as a cushion in case the pinion and gear teeth butt instead of meshing. The helical splines assist in obtaining proper pinion engagement. The drive pinion is pulled out of engagement, after engine starts, by action of the shift lever return spring. The shift lever is connected to the solenoid switch plunger by a roll pin. See Figure 10-26.

The high torque cranking motor has two parallel field coils connected to the insulated brushes, and two shunt field coils connected to ground. The purpose of this design is to increase starting torque. Heavier field and armature windings help accomplish this. The additional shunt field is required to control free speed of the motor. See Figure 10-27.

b. Solenoid Switch

The solenoid switch not only closes the circuit between the battery and the cranking motor to produce cranking action, but it also operates the shift lever to move the drive pinion into engagement with the flywheel ring gear.

The solenoid section of the switch has a plunger and two windings, the "pull-in" winding and the "hold-in" winding. Together, they provide sufficient magnetic attraction to pull the solenoid plunger into the solenoid. The plunger actuates the shift lever and drive assembly and it also closes the solenoid switch contacts by pressing against a push rod upon which a contact disk is mounted between two coil springs. One spring serves as a cushion to insure firm contact of the disk with two stationary contacts. The other spring pushes the disk away from the stationary contacts to break the circuit when the solenoid is demagnetized after the engine starts. One stationary contact is connected to the battery positive cable and the other is connected to the motor windings through a connector or bus bar. See Figure 10-26.

Operation of solenoid switch, as well as the entire cranking system, is described in paragraph 10-23.

10-26 TROUBLE-SHOOTING CRANKING SYSTEM

a. No Cranking Action

1. Make sure that control lever is in neutral (N) or park (P) position.

2. Make quick check of battery and cables (par. 10-11). If battery is low, the solenoid usually will produce a clattering noise, because a nearly discharged battery

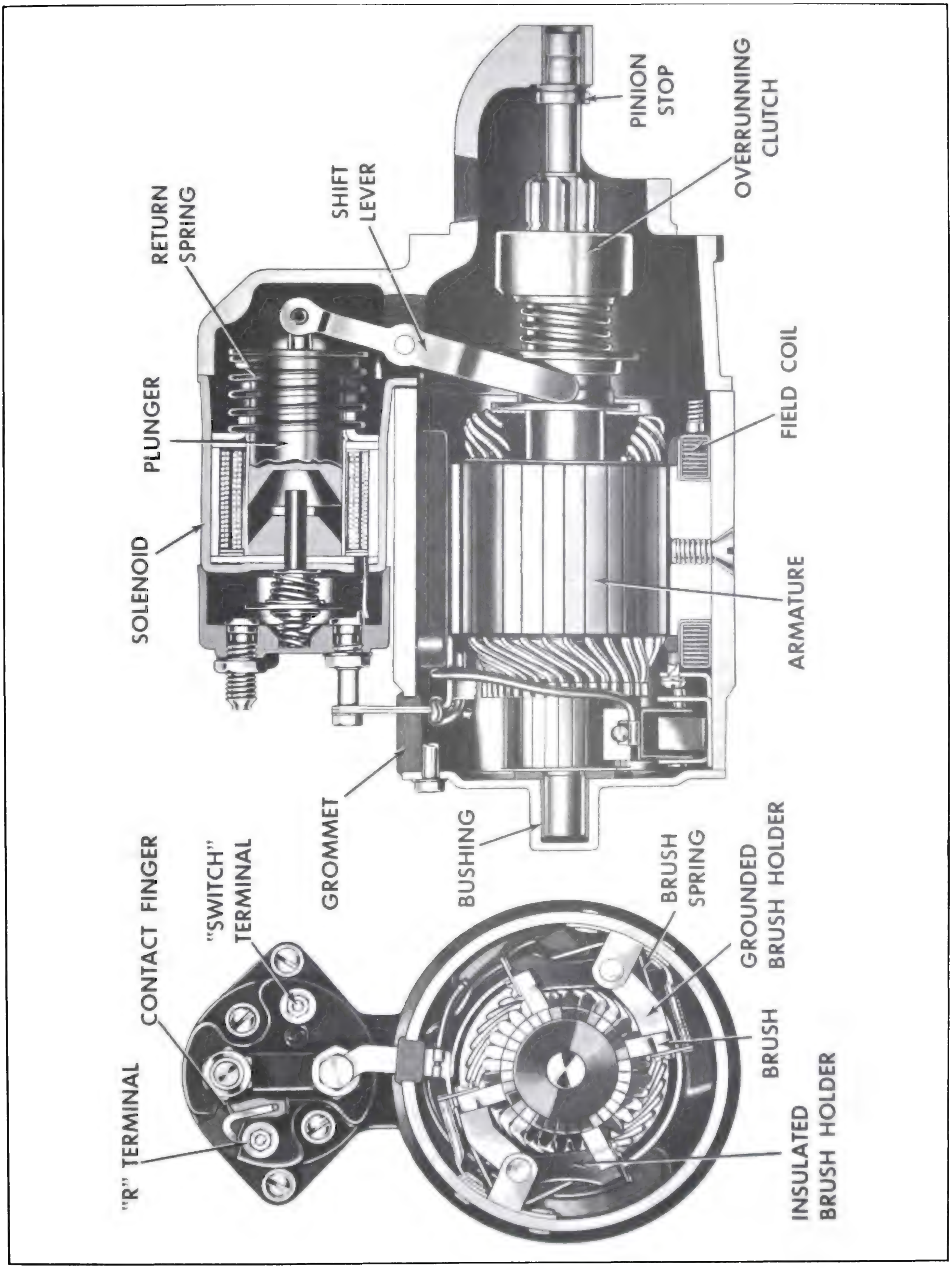


Figure 10-26—Cranking Motor

will not sustain the voltage required to hold solenoid plunger in after solenoid switch has been closed.

3. If cranking motor spins and drive pinion engages ring gear but does not drive it, overrunning clutch is slipping. Remove motor to replace drive assembly.

4. If cranking motor does not operate, note whether solenoid plunger is pulled into solenoid when solenoid circuit is closed. Ordinarily the plunger makes a loud click when it is pulled in. If plunger is pulled in, solenoid circuit is okay and trouble is in solenoid switch, cranking motor, or cranking motor circuit. The cranking motor must be removed for repairs to switch or motor (par. 10-30).

5. If plunger does not pull into solenoid when ignition switch is turned to "START", the solenoid circuit is open, or solenoid is at fault.

6. To find reason why plunger does not pull into solenoid, disconnect purple solenoid wire at connector near battery terminal block and press wire end against post of terminal block. If cranking motor operates, solenoid is okay; trouble is in ignition switch, neutral safety switch, or in wires and connections between these units.

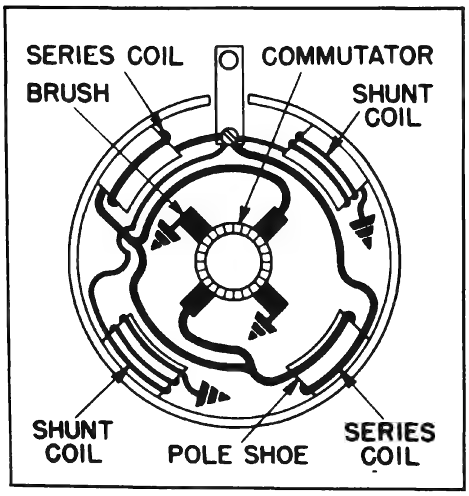


Figure 10-27—Cranking Motor Circuits-401 and 425 Engines

7. As a final test, connect jumper between solenoid battery terminal and terminal on solenoid switch to which purple wire is connected. If cranking motor still does not operate, remove motor for inspection and test of solenoid switch (par. 10-29).

b. Cranking Speed Abnormally Low

Abnormally low cranking speed may be caused by low battery or defective cables, defective solenoid switch, defective cranking motor, or an internal condition of engine.

1. Make quick check of battery. If low battery is indicated, test battery (par. 10-9). If defective cables are indicated, test cables (par. 10-11).

2. If battery and cables are okay, test cranking motor and solenoid switch (par. 10-28).

3. If cranking motor and solenoid switch test okay, the trouble is due to an internal condition of engine. This may be due to use of engine oil which is too heavy for prevailing temperatures.

10-27 PERIODIC INSPECTION OF CRANKING MOTOR

No periodic lubrication of the cranking motor or solenoid is required. The cranking motor and brushes cannot be inspected without disassembling the unit so no service is required on the cranking motor and solenoid between inspection periods.

Cranking motor action is indicative, to some extent, of the cranking motor condition. A cranking motor that responds readily and cranks the engine at normal speed when the control circuit is closed is usually in good condition.

Check motor and solenoid switch attaching bolts to make sure these units are solidly mounted. Inspect and manually check all wiring connections at solenoid switch, ignition switch, and neutral safety switch. Make sure that all these connections in the cranking motor and control circuits are clean and tight. It is advisable to test the cranking circuit to make certain that excessive resistance does not exist. See paragraph 10-28.

10-28 VOLTAGE TEST OF CRANKING SYSTEM AND SOLENOID SWITCH

The voltage across the cranking motor and switch while cranking the engine gives a good indication of any excessive resistance. NOTE: Engine must be at normal operating temperature when test is made.

1. Inspect battery and cables (par. 10-11) to make certain that battery has ample capacity for cranking and ignition.

2. Connect jumper wire to distributor terminal of coil and to ground on engine, so that engine can be cranked without firing.

3. Connect voltmeter positive (+) lead to the motor terminal on solenoid switch; connect voltmeter negative (-) lead to ground on starter. See Figure 10-28.

4. Turn ignition switch on, crank engine and take voltmeter reading as quickly as possible. If cranking motor turns engine at normal cranking speed with voltmeter reading 9 or more volts, the motor and switch are satisfactory. If cranking speed is below normal and voltmeter reading is 9 or greater, the cranking motor is defective.

CAUTION: Do not operate cranking motor more than 30 seconds at a time without pausing to allow motor to cool for at least two minutes; otherwise, overheating

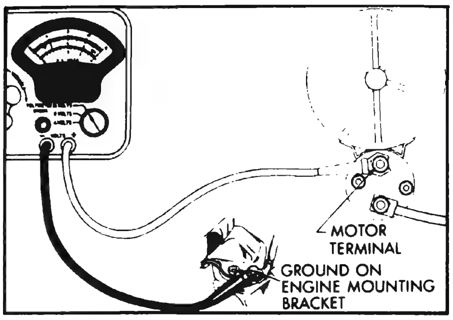


Figure 10-28—Cranking Voltage Test Connections

and damage to motor may result.

5. If cranking motor turns engine at low rate of speed with voltmeter reading less than 9 volts, test solenoid switch contacts as follows:

6. With voltmeter switch turned to any scale above 12 volts, connect voltmeter negative (-) lead to the motor terminal of solenoid switch, and connect positive (+) lead to battery terminal of switch. See Figure 10-29.

7. Turn ignition switch on and crank engine. Immediately turn voltmeter switch to low scale and take reading as quickly as possible, then turn switch back to higher scale and stop engine.

The voltmeter will read not more than 1/10 volt if switch contacts are satisfactory. If voltmeter reads more than 1/10 volt, switch should be repaired or replaced.

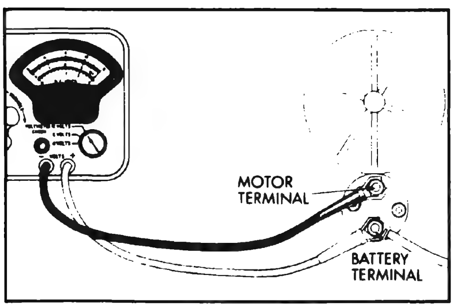


Figure 10-29—Solenoid Switch Contact Test Connections

10-29 AMPERAGE TEST OF SOLENOID AND PINION CLEARANCE CHECK

a. Testing Solenoid Switch Windings

(1) Current draw of both windings in parallel.

(2) Current draw of hold-in winding alone.

1. Remove screw from solenoid motor terminal and bend field leads slightly until clear of terminal. Then ground solenoid motor terminal with a heavy jumper wire. See Figure 10-30.

2. Connect a 12-volt battery, a variable resistance, and an ammeter of 100 amperes capacity in series with solenoid "S" terminal. Connect a heavy jumper wire from solenoid base to ground post of battery.

3. Connect a voltmeter between base of solenoid and small solenoid "S" terminal.

4. Slowly adjust resistance until voltmeter reads 10 volts and note ammeter reading. This shows current draw of both windings in parallel, and should be 41 to 47 amperes (large starter) or 42 to 49 amperes (small starter). See Figures 10-24 and 25 for diagrams of solenoid circuits.

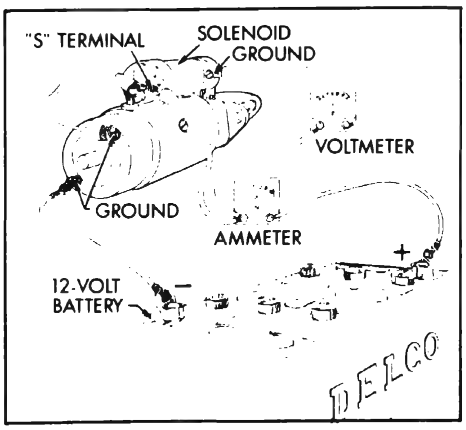


Figure 10-30—Amperage Test of Solenoid

5. Remove jumper wire from solenoid motor terminal and readjust resistance until voltmeter reads 10 volts, then note ammeter reading. This shows current draw of hold-in winding alone, and should be 14.5 to 16.5 amperes (large starter) or 10.5 to 12.5 amperes (small starter), with solenoid at room temperature.

6. If solenoid windings do not test within specifications given, solenoid switch assembly should be replaced.

b. Checking Pinion Clearance

Whenever the cranking motor is disassembled and reassembled, the pinion clearance should be checked. This is to make sure that proper clearance exists between the pinion and pinion stop retainer when pinion is in cranking position. Lack of clearance would prevent solenoid starter switch from closing properly; too much clearance would cause improper pinion engagement in ring gear.

1. Connect a source of approximately 6 volts (3 battery cells or a 6 volt battery) between the solenoid "S" terminal and ground. CAUTION: Do not use more than 6 volts or the motor will operate. As a further precaution to prevent motoring, connect a heavy jumper wire from the solenoid motor terminal to ground.

2. After energizing the solenoid, push the pinion away from the stop retainer as far as possible and use feeler gauge to check clearance between pinion and retainer. See Figure 10-31. .

3. If clearance is not between .010" and .140", it indicates excessive wear of solenoid linkage, shift lever mechanism, or improper assembly of these parts. NOTE: Pinion clearance cannot be adjusted. If clearance is not correct, motor must be disassembled and checked for the above mentioned defects. Any defective parts must be replaced.

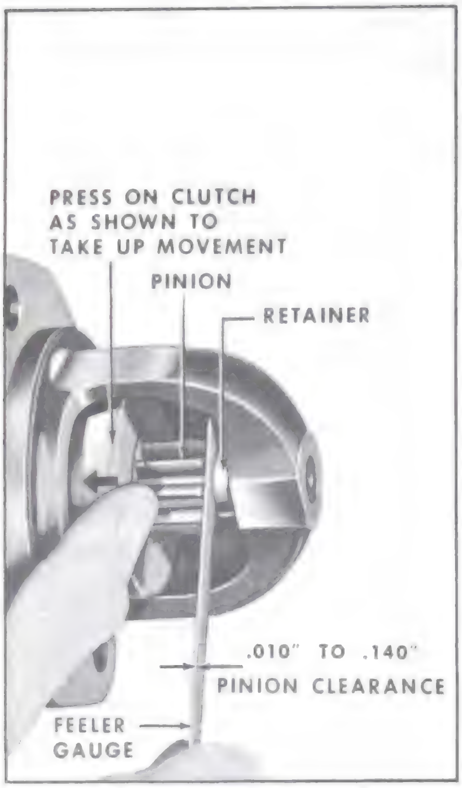


Figure 10-31—Checking Pinion Clearance

10-30 BENCH TEST OF CRANKING MOTOR

To obtain full performance data on a cranking motor, or to determine the cause of abnormal operation, the motor should be removed from the engine and be submitted to a no-load and a locked armature test with equipment designed for such tests. A high current carrying variable resistance should be connected into the circuit so that the specified voltage at the cranking motor may be obtained, since a small variation in the voltage will produce a marked difference in the current draw. Test specifications are given under Electrical Specifications in paragraph 10-3.

(a) No-load Test. Connect the cranking motor in series with a 12-volt battery and an ammeter capable of indicating several hundred amperes. If an RPM indicator is available, set it up to read armature RPM. Check current draw and armature RPM at the specified voltage.

(b) Locked Armature Test. With the armature locked, check current draw at the specified voltage.

Rated current draw and no-load speed indicates normal condition of cranking motor. Abnormal conditions may be indicated by one of the following:

1. Low no-load speed and high current draw may result from:

(a) Tight, dirty, or worn bearings, bent armature shaft or loose field pole screws which would allow the armature to drag.

(b) Shorted armature. Check armature further on growler (par. 10-20).

(c) A grounded armature or field.

Check for grounds by raising the grounded brushes and insulating them from the commutator with cardboard. If the cranking motor has shunt field coils which are grounded to the field frame (see Figure 10-27), disconnect these fields from ground. Then check with a test lamp between the insulated terminal and the frame. If lamp lights, raise other brushes from commutator and check fields separately to determine whether it is the fields or armature that is grounded.

2. Failure to operate with high current draw may result from:

(a) a direct ground in the terminal or fields.

(b) Frozen shaft bearings which prevent the armature from turning.

3. Failure to operate with no current draw may result from:

(a) Open field circuit. Inspect internal connections and trace circuits with test lamp.

(b) Open armature coils. Inspect the commutator for badly burned bars.

(c) Broken or weakened brush springs, worn brushes, high mica on the commutator, or other causes which would prevent good contact between the brushes and commutator. Any of these conditions will cause burned commutator bars.

4. Low no-load speed with low current draw indicates.

(a) An open field winding. Raise and insulate ungrounded brushes from commutator and check fields with test lamp. See Figure 10-27.

(b) High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under item 3 (c).

5. High no-load speed with high current draw indicates shorted fields. There is no easy way to detect shorted fields, since the field resistance is already low. If shorted fields are suspected, replace the fields and check for improvement in performance.

10-31 CRANKING MOTOR REPAIRS—ON BENCH

a. Disassembly, Cleaning and Inspection

When it is necessary to disassemble cranking motor for any reason, make a complete cleanup and inspection to make sure all parts are in satisfactory condition. See Figure 10-26 for identification of parts.

1. Remove field lead connecting screw from motor terminal of solenoid.

2. Remove two thru bolts and remove commutator end frame and field frame assembly.

3. Pull out brush holder pivot pin and remove the two brush holders and the spring as a group. Remove screws attaching brushes and leads to holders.

4. Remove two screws holding solenoid to drive housing and remove solenoid. Remove small nut

and insulating washer from the solenoid "S" terminal. Remove large nut and insulating washer from the solenoid battery terminal. See **Figure 10-26.** Then, remove two screws that attach switch cover to solenoid and remove cover for inspection of switch parts.

5. Remove shift lever fulcrum bolt and remove shift lever, plunger and return spring.

6. Remove two screws holding center bushing plate to drive housing. Remove armature and drive assembly from drive housing. Remove thrust collar from pinion end of armature shaft.

7. To remove drive assembly from armature, place a metal cylinder of proper size (1/2" pipe coupling will do) over end of shaft to bear against the pinion stop retainer. Tap retainer toward armature to uncover snap ring. See **Figure 10-32.** Remove snap ring from groove in shaft, then slide retainer and pinion drive assembly from shaft.

8. Clean all parts by wiping with clean cloths. The armature, field coils, and drive assembly must not be cleaned by any degreasing or high temperature method. This might damage insulation so that a short or ground would subsequently develop, and will remove lubricant originally packed in the overrunning clutch so that clutch would soon be ruined.

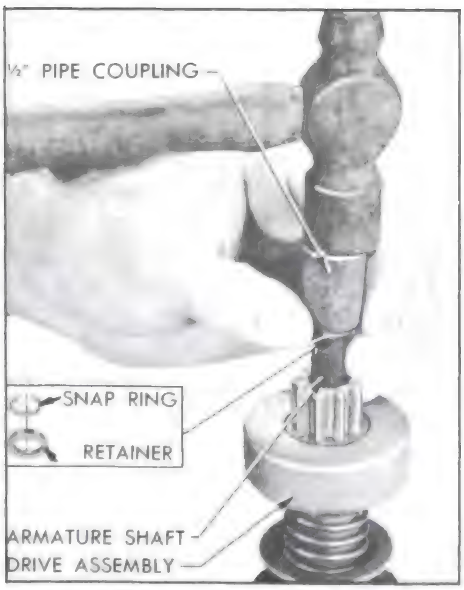


Figure 10-32—Removing Pinion Stop Retainer and Snap Ring

9. Carefully inspect all parts for wear or damage and make necessary repairs or replace unserviceable parts. Any soldering must be done with rosin flux; never use acid flux on electrical connections.

10. Test armature and make necessary repairs or turn commutator if required, following the same procedure as specified for generator in paragraph 10-20.

b. Assembly of Cranking Motor

1. Lubricate shift lever linkage and install in drive housing. CAUTION: Never lubricate solenoid plunger or plunger cylinder.

2. Assemble solenoid by reversing the disassembly procedure. Install return spring. Apply sealing compound on both sides of solenoid flange where it extends between drive housing and field frame. Then install solenoid.

3. Lubricate armature shaft with silicone grease. Install drive assembly with pinion outward.

4. Slide pinion stop retainer down over shaft with recessed side outward.

5. Place a new snap ring on drive end of shaft and hold it in place with a hard wood block. Strike block with hammer to force snap ring over end of shaft, then slide the ring down into groove in shaft. See **Figure 10-33, View A.**

6. Place thrust collar on shaft with shoulder next to snap ring, and move the retainer into contact with ring. Using pliers on opposite sides of shaft squeeze retainer and thrust collar together until snap ring is forced into the retainer. See **Figure 10-33, View B.**

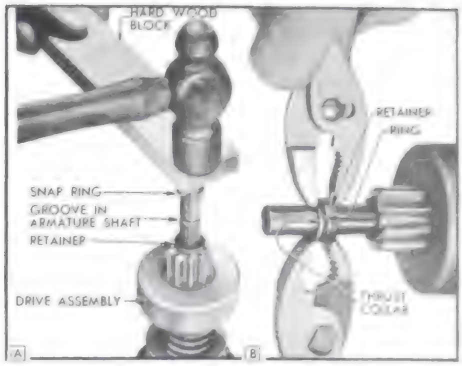


Figure 10-33—Pinion Stop Retainer and Snap Ring Installation

7. Lubricate drive housing bushing with silicone grease and install armature and drive assembly in housing.

8. Continue with assembly of cranking motor by reversing disassembly procedure. If field coils were removed from field frame, use care in tightening pole shoe screws to avoid distortion of parts and make sure that screws are securely tightened.

9. Position field frame assembly over armature assembly so that dowel pin engages hole in drive housing. Use care to prevent damage to brushes and brush holders. Make sure that brushes are properly seated on commutator.

10. Install thrust washer on commutator end of armature assembly. Lubricate bushing in commutator end frame with silicone grease and install end frame.

11. Install thru bolts and tighten securely. Connect field leads to motor terminal of solenoid with connecting screw.

12. Test solenoid switch and check pinion clearance as described in paragraph 10-29. If a reliable starter tester is available, test motor as described in paragraph 10-30.

SECTION 10-E

IGNITION SYSTEM

CONTENTS OF SECTION 10-E

10-32 IGNITION SYSTEM DESCRIPTION AND OPERATION

a. Ignition System Components

The ignition system consists of the ignition switch, ignition coil resistance wire, ignition coil, ignition distributor, spark plugs, and the low and high tension wiring. Electrical energy is obtained from the battery while cranking and during idle speeds, and from the generator at higher speeds. These supply circuits must be considered part of the ignition system.

1. Ignition Switch. The ignition switch has five positions. Starting with the full counterclockwise position, these positions are: "ACC", "LOCK", "OFF", "ON" and "START". There are three positions between which the switch can be turned without the ignition key in the lock cylinder - "OFF", "ON" and "START". The ignition key can be freely inserted or removed in any position except "OFF" or "ACC.". In "OFF", the key must be rotated slightly clockwise before it can be removed; this is to prevent the ignition switch from being left unlocked unintentionally. In "ACC.", the key cannot be removed; this is to prevent the radio or other accessories from being left on accidentally.

(a) In "ACC.", a connection is made from the battery terminal to the accessory terminal of the switch to allow accessories such as the radio, blower and/or windshield wiper to be operated with the ignition, fuel gauge and indicator light circuits off.

(b) In "LOCK", no accessory supplied through the ignition switch can be operated. Also, the resistance wire circuit to the ignition coil (IGN) is grounded.

(c) In "OFF", no accessory supplied through the switch can be operated.

(d) In "ON", a connection is made from the battery terminal to the accessory terminal so that all ignition switch supplied accessories can be operated. Also the battery is connected to the resistance wire leading to the ignition coil (IGN). From this same terminal, a lead into the instrument cluster energizes the fuel gauge and indicator lights.

(e) In "START", all ignition switch supplied accessories are temporarily disconnected. A connection is made to the starter solenoid lead. The water temperature light circuit is temporarily grounded to provide a means of checking the "TEMP." light bulb. When the ignition switch is released, a spring returns it to "ON".

2. Ignition Coil Resistance Wire. The ignition coil resistance wire is an integral part of the instrument panel wiring harness. This resistance wire is connected between the ignition switch and the positive (+) terminal of the coil. The resistance wire limits to a safe maximum the primary current flow through the coil and the distributor contact points, thereby protecting the contact points during slow speed operation when they are closed for longer intervals. It also protects against excessive build up of primary current when the ignition switch is closed with engine stopped and contact points closed.

When the ignition switch is in the "START" position, and the starter is cranking, a connection is made from starter solenoid directly to the positive terminal of the ignition coil, by-passing the resistance. Elimination of the resistance overcomes the effects of reduced voltage due to cranking motor drain on the battery.

3. Ignition Coil. The oil filled ignition coil is mounted on the intake manifold, adjacent to the ignition distributor. The positive (+) terminal is connected to the ignition switch through the resistance wire, and is also connected directly to the starter solenoid to by-pass the resistance wire during cranking of engine.

The negative (-) terminal is connected to the distributor. The secondary (high tension) terminal is connected by a short cable to the center terminal in the distributor cap.

4. Ignition Distributor. The ignition distributor is of the external adjustment type. It is driven clockwise directly from the camshaft through cast iron gears which are automatically lubricated by the engine oiling system. Contact point opening is adjusted through a window in the distributor cap while the engine is idling. Any accurate dwell meter may be used. See paragraph 10-34 for adjustment procedure.

The distributor is of the single contact type with an 8-lobe cam. High speed operation is improved by an especially light contact breaker arm and a high speed cam. Maximum operating efficiency of the engine is obtained under all speed and load conditions by the centrifugal advance mechanism, which is located above the circuit breaker cam inside the rotor, and the vacuum advance mechanism built into the distributor. See Figure 10-34.

The contact point set is replaced as one complete assembly. The service replacement contact set has the breaker lever spring tension and point alignment adjusted at the factory. Only the point opening requires adjusting after replacement.

5. Spark Plugs. AC spark plugs having 14 MM threads, short (3/8") terminals, and .035" gaps are specified. For service information on spark plugs and wires, see paragraph 10-36.

6. Radio Suppression. All secondary wiring has a resistance of 4000 ohms per foot so that it is unnecessary to install a suppressor on the high tension cable when a radio is installed. A capacitor is mounted on the side of ignition coil and connected to the positive

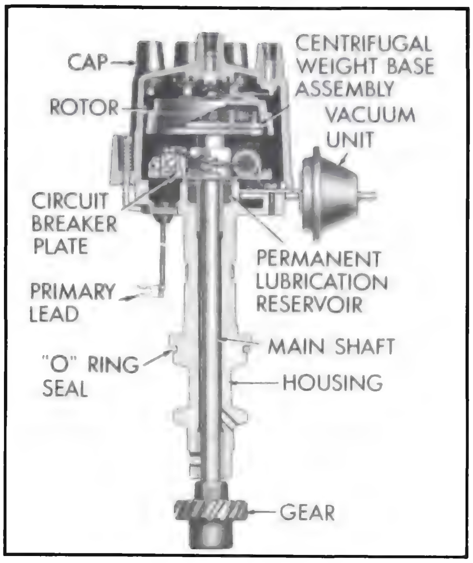


Figure 10-34—Distributor and Cap Assembly

(battery) terminal of coil when a radio is installed.

An additional capacitor must never be connected to the distributor terminal as this will cause excessive pitting of breaker points or engine missing.

b. Ignition Operating Circuits

To clarify operating principles as well as to simplify the process of tracing troubles, the parts of the ignition system should be understood to provide two separate and distinct circuits, as follows:

1. The Primary Circuit carries the low voltage current supplied by the battery or generator. In addition to these sources of electrical energy, the primary circuit contains the ignition switch, ignition coil resistance unit, primary winding of the ignition coil, distributor contact points, condenser, and all connecting low tension wiring.

2. The Secondary Circuit carries the high voltage surges produced by the ignition coil, which result in high voltage spark between the electrodes of the spark plugs in engine cylinders. This circuit contains the secondary winding of the ignition coil, coil to distributor high tension lead, distributor rotor and cap, ignition cables, and spark plugs.

c. Cycle of Operation

When the ignition switch is turned on and the distributor contact points are closed, battery or generator current flows through the primary winding of the coil and through the contact points to ground. This flow of current through the primary winding of the coil produces a magnetic field around the coil windings and thereby stores electrical energy in the coil.

When the contact points are separated by the revolving distributor cam, the primary circuit is broken. The condenser absorbs the current which tends to surge across the gap as the points separate, thereby producing a sharp break in the flow of current. If the flow of current were not sharply broken it would form an arc which would burn the points badly and would also drain away most of the energy stored in the coil. There would be insufficient energy left in the coil to produce the necessary high voltage surge in the secondary circuit.

The very rapid change in strength of the magnetic field when the primary circuit is sharply broken causes a high voltage to be induced in every turn of both the primary and secondary windings. The high voltage surge produced in the secondary winding of the coil travels through the cable to the center of distributor cap, through the rotor to the adjacent distributor cap segment from which it is conducted to the proper spark plug by the ignition cable. The high voltage surge jumps the gap between the insulated center electrode and the grounded side electrode of the spark plug, thus producing the spark required to ignite the charge in the selected combustion chamber of the engine.

As the spark appears at the spark plug gap the energy in the coil begins to drain from the coil through the secondary circuit, thus sustaining the spark for a small fraction of a second. During this interval the condenser discharges back through the primary circuit, producing an oscillation of the current flow in the primary circuit during the brief instant that is required for the primary circuit to return to a state of equilibrium. Note particularly that the ignition condenser does not discharge until after the spark has occurred at the spark plug gap.

The sequence of action described above is repeated as each lobe of the distributor cam moves under and past the rubbing block on the contact breaker arm to cause the contact points to close and open.

d. Control of Spark Timing

The timing of the spark with respect to piston position in the cylinder must vary in accordance with operating conditions if best engine performance is obtained. The spark advance for obtaining satisfactory idling should be as low as possible. At high speed, the spark must occur earlier in the compression stroke in order to give the fuel-air mixture ample time to ignite, burn and deliver its power to the piston as it starts down on the power stroke.

Under part throttle light load operation, a smaller amount of fuel-air mixture (by weight) enters the cylinder so that the mixture is less highly compressed. Under this condition, advancing the spark permits fuller utilization of the fuel-air charge. During acceleration or on heavy loads (wide open throttle) the spark advance required to develop the maximum power of the engine is considerably less than that required for light loads.

Control of spark timing to satisfy these constantly changing operating requirements is obtained in three ways, as follows:

1. Initial, manual setting of distributor is made so that contact points open at a specified position of piston, as indicated by a timing mark on crankshaft balancer. See Ignition Timing (par. 10-35)

2. Centrifugal Advance is governed by engine speed. The centrifugal advance mechanism is located above the circuit breaker cam inside the rotor and consists of an advance cam which is integral with the distributor shaft, a pair of advance weights, two springs, and a weight base plate which is assembled to the distributor cam.

At idle speeds, the springs hold the advance weights as shown in Figure 10-35A, so that there is no spark advance and the spark occurs in accordance with the initial manual setting of distributor.

As speed increases, centrifugal force causes the advance weights to throw outward and push against the advance cam, thus rotating the weight base plate and integral distributor cam ahead of the distributor shaft. This causes the distributor cam lobes to open and close the contact points earlier in the compression stroke so that the spark is advanced. See Figure 10-35B.

3. Vacuum Advance is governed by manifold vacuum. The contact point set is mounted on a breaker plate which is located below the centrifugal advance mechanism and uses the outer diameter of the upper shaft bushing for its bearing surface. The movable breaker plate is held in position on the upper shaft bushing by a retainer. The vacuum unit is mounted on the distributor base and under the movable breaker plate so that the breaker plate can be rotated around the distributor cam by a link from the vacuum unit. See Figure 10-36.

The vacuum unit contains a spring-loaded diaphragm. The spring-loaded side of the diaphragm is connected by a hose to an opening in the carburetor barrel. This opening may be above or below the edge of the throttle valve when the engine is idling, depending on carburetor design. If the opening is below the throttle valve, the distributor will always have vacuum advance, even at idle; if the opening is above the throttle valve at idle, the vacuum advance unit will not begin to operate until the throttle is opened slightly, causing the edge

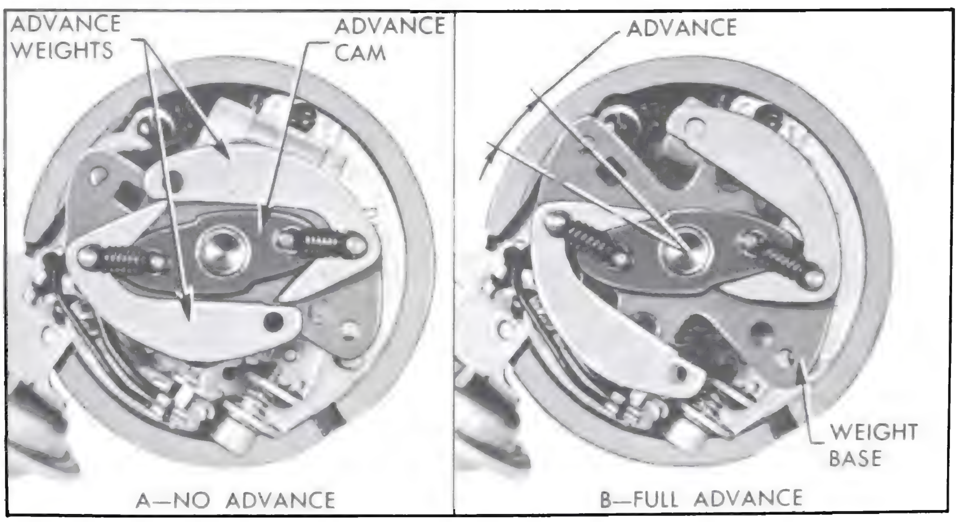


Figure 10-35—Centrifugal Advance Mechanism

of the throttle valve to move above the opening.

The vacuum at the opening acts on the control diaphragm, causing it to compress the spring and to rotate the breaker plate in a counterclockwise direction. This moves the contact points so that the distributor cam lobes open the points earlier in the compression stroke. The amount of throttle opening and the engine load determine the amount of intake manifold vacuum and thus the amount of spark advance obtained. The advance obtained by the vacuum control is added to the advance obtained by the centrifugal advance mechanism as shown in Figures 10-37 through 10-39.

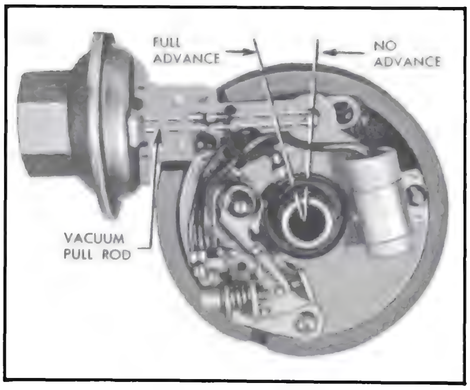


Figure 10-36—Vacuum Advance Mechanism

10-33 IGNITION SYSTEM—TROUBLE DIAGNOSIS

If engine trouble has arisen which seems to be due to improper operation of the ignition system, it may be desirable to make a quick preliminary check of the ignition system before making a complete analysis, in order to determine whether the ignition system is actually at fault. The quick checks described in this paragraph may be used but it must be understood that they are no substitute for the complete ignition system inspection. The checks to be made depend on whether the engine will or will not run.

a. Engine Will Not Run

1. Make quick check of battery and cables (par. 10-11) if cranking motor does not turn engine at normal cranking speed.

2. Pull coil high tension cable from distributor cap and hold the lead terminal about 3/16" from a clean ground point on engine. If a good spark occurs while engine is being cranked, the primary circuit and the secondary circuit to this point may be considered to be okay. Proceed with Steps 3 through 6.

3. Remove distributor cap and check interior for moisture, corroded terminal segments, and check terminal sockets for corrosion. Check rotor for corrosion. Clean off corrosion and wipe distributor cap dry. Check for a crack or carbon path in cap or rotor.

4. Inspect ignition cables for possible short circuits and corroded terminals. Remove and inspect spark plugs (par. 10-36).

5. If cause of trouble has not been found, check approximate ignition timing (par. 10-35).

6. If engine still fails to run, the trouble is probably due to causes other than ignition, such as lack of fuel, carburetion, or compression loss.

7. If spark did not occur at coil high tension lead (Step 2 above) then connect 12-volt test lamp between distributor terminal of coil and ground and crank engine. If test light flickers on and off as engine is cranked the primary circuit is probably okay. Check ignition coil (par. 10-37) and condenser (par. 10-38).

8. If test light remains on as engine is cranked, contact points are not closing properly; check point opening and ground connection in distributor (par. 10-39).

9. If test light remains off as engine is cranked, the primary circuit is open or the points are not opening properly. Check for loose connections, broken leads, defective switch, contact point opening, and primary circuit winding in coil. Visual inspection of points and the use of a test lamp or voltmeter will locate the source of this trouble.

b. Engine Runs, But Not Satisfactorily

1. When missing, loss of power, or hard starting is present a complete checkup of the ignition system is in order, since these conditions may result from anything from a low battery to defective spark plugs, or from other engine conditions not related to ignition. In this case, the complete inspection of ignition system should be used.

2. Detonation may be caused by improper timing (par. 10-35), improper operation of centrifugal or vacuum advance mechanism (par. 10-32, d), worn distributor bearings or a bent shaft, dirty or wrong heat range spark plugs (par. 10-36). It may also be caused by overheating, excessive carbon in cylinders, or by low octane fuel.

3. Overheating may be caused by one or more of the conditions which contribute to detonation, as well as by faults in engine cooling system.

10-34 REPLACEMENT AND ADJUSTMENT OF DISTRIBUTOR CONTACT POINT SET

When inspection of the contact points as described in paragraph 10-39 shows replacement to be advisable, the following procedure should be used.

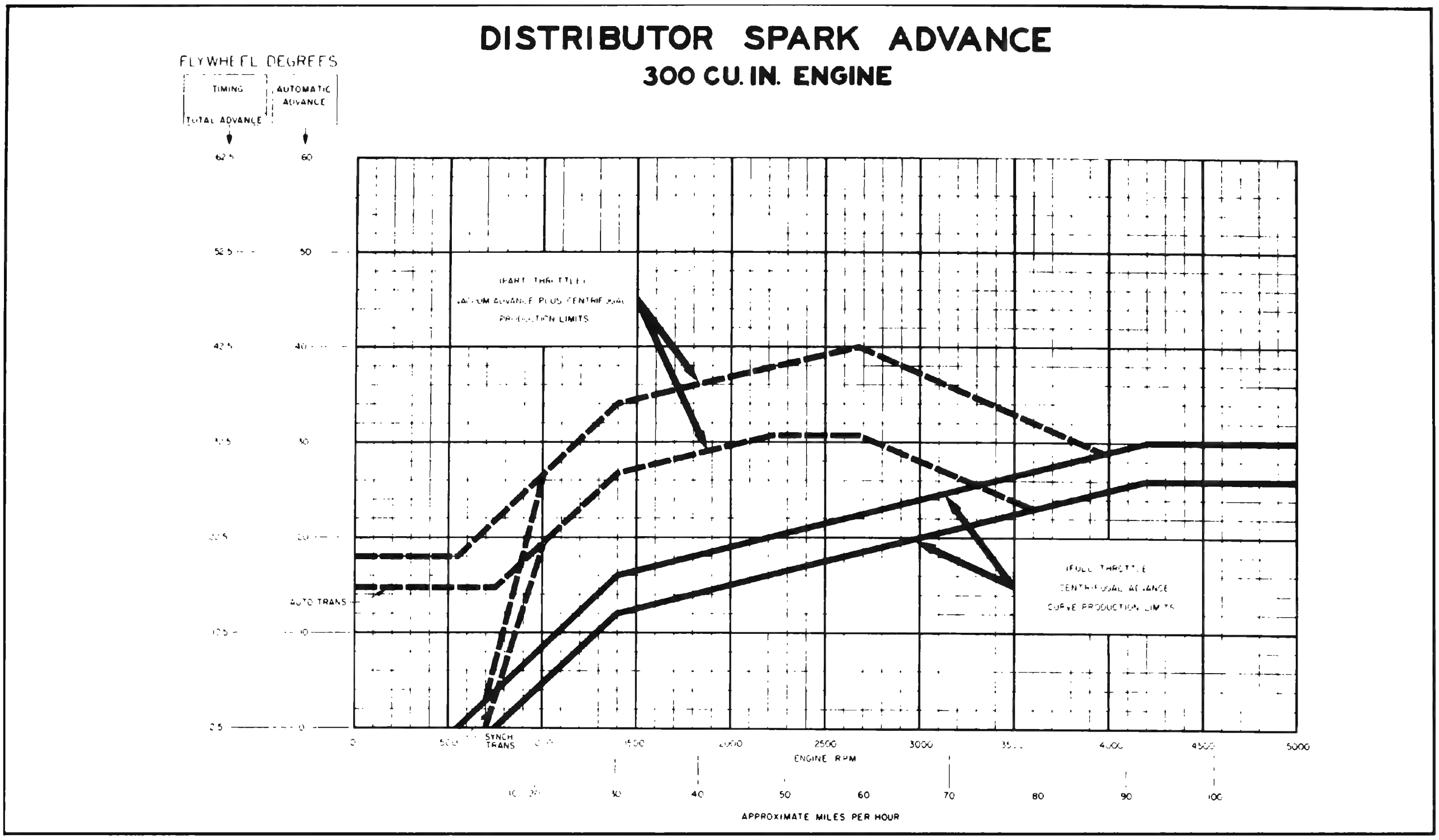


Figure 10-37—Distributor Spark Advance Chart-300 Engine

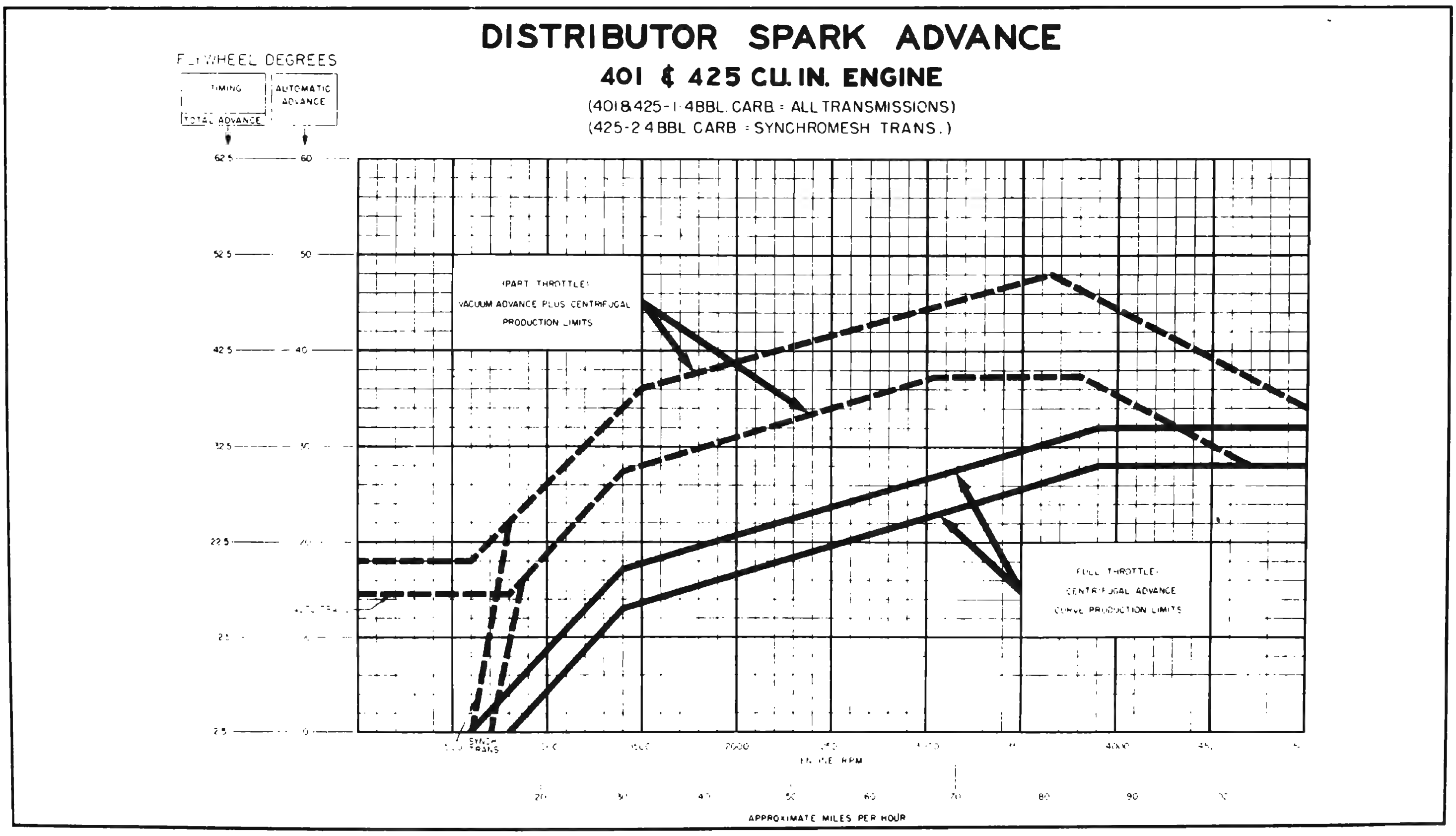


Figure 10-38—Distributor Spark Advance Chart-401 and 425 Engines (Except Dual 4-Bbl. with Auto. Trans.)

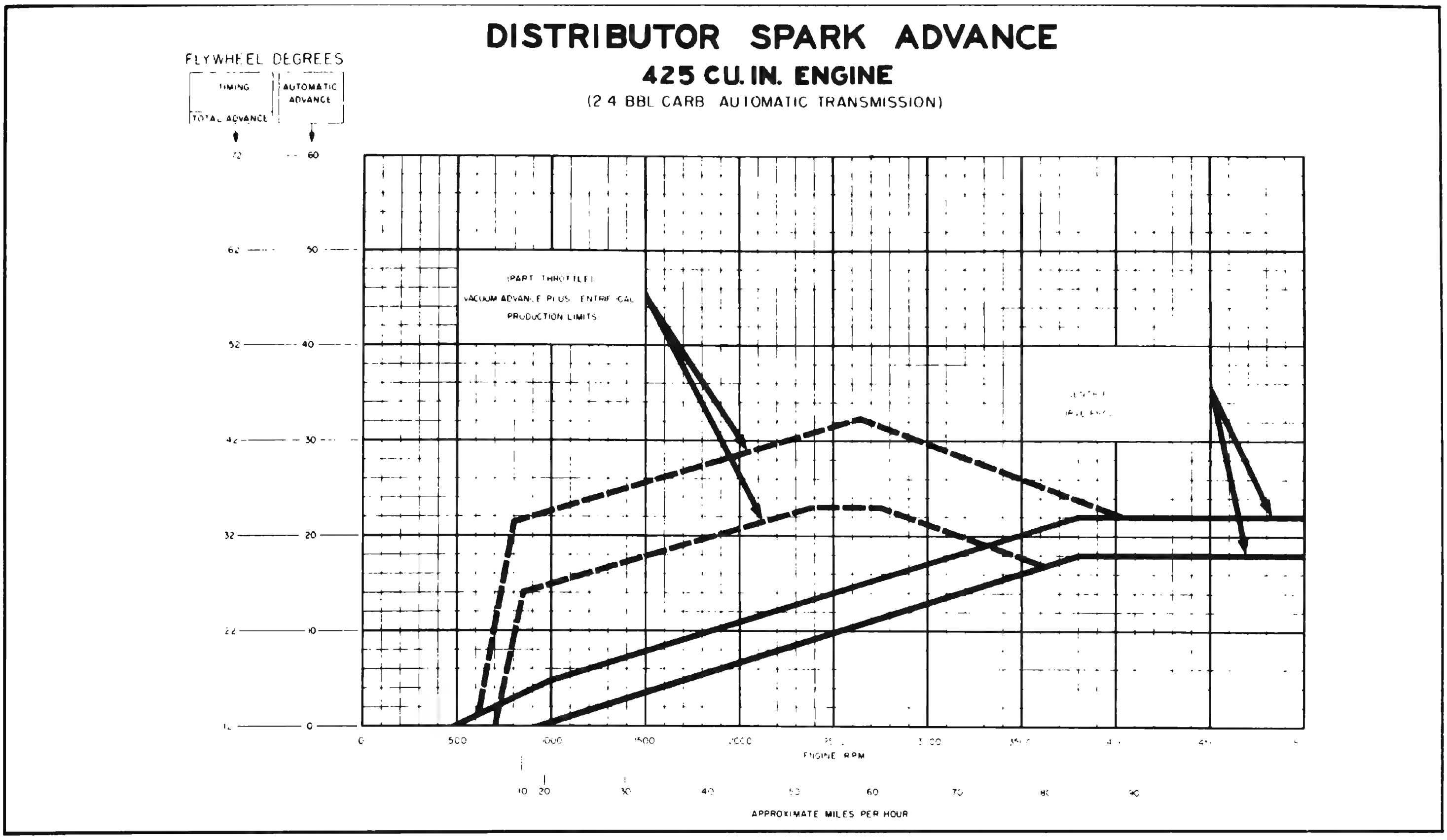


Figure 10-39—Distributor Spark Advance Chart-425 Engine with Dual 4-Bbl. and Auto. Trans.

NOTE: The service replacement contact point set has the breaker spring tension and point alignment adjusted at the factory.

a. Removal of Contact Point Set

1. Remove distributor cap by inserting a screwdriver in upper slotted end of cap retainers, press down and turn 90° counterclockwise. Push distributor cap aside and remove rotor. Disconnect the condenser and primary leads from their terminal by loosening the retaining screw.

2. Loosen two screws and lock washers which hold the contact point set in place. Then remove point set.

b. Installation of Contact Point Set

1. Apply a thin layer of high temperature cam and ball bearing lubricant to cam.

2. Slide contact point set over boss on breaker plate and under the two screw heads. Tighten two screws and lock washers.

3. Install condenser and primary leads.

NOTE: Leads must be properly positioned so they will not come in contact with bottom of weight base or rotor.

4. If engine does not start readily, position contact arm rubbing block on peak of cam lobe, insert a 1/8" Allen wrench in adjusting screw and turn screw in (clockwise) until contact points just close. Then back screw out (counterclockwise) 1/2 turn (180°) to obtain a point gap of approximately .016" for a preliminary setting.

c. Adjustment of Contact Points—Engine Running

NOTE: When adjusting contact point dwell angle, always follow the instructions which come with the dwell meter.

1. Connect dwell tester leads: red to distributor side of coil, black to ground.

2. Turn selector switch to position for 8-lobe cam. Turn ignition switch on.

3. Start engine. Lift adjustment window and insert 1/8" Allen wrench in adjusting screw. See Figure 10-41. Set dwell angle at 30 degrees.

4. After adjusting dwell angle, always check ignition timing.

10-35 IGNITION TIMING

The timing mark is a groove filled with yellow paint, which is on the rear edge of the harmonic balancer. On 401 and 425 engines, the timing indicator, a part of the timing chain cover, has three ridges outlined with yellow paint. These ridges indicate U. D. C.

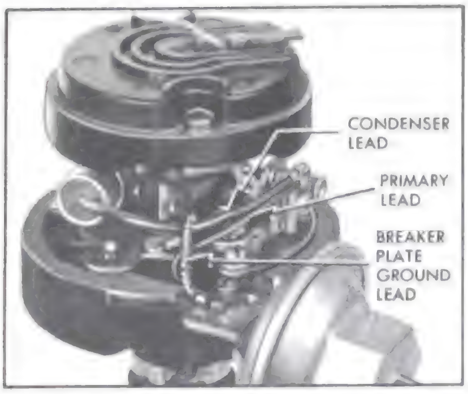


Figure 10-40—Locating Leads in Distributor

(marked "0"), "5" degrees, and "12" degrees before U.D.C. See Figure 10-43.

On 300 engines, the timing indicator is marked "0", "5", "10" and "15". See Figure 10-42.

Correct timing exists when the yellow timing mark on the harmonic balancer is halfway between the "0" and the "5" degree marks on the timing indicator, with the engine running at correct idle speed (vacuum hose disconnected). Dual 4-barrel cars with automatic transmission are timed at 12 degrees.

a. Preliminary Timing (Engine Won't Run)

CAUTION: If the engine must be cranked from under the hood or under the car to change its rotational position for any assembly operation, this cranking can only be done in the "ACC." position. Since the ignition system primary is grounded inside the ignition switch in the "OFF" and "LOCK" positions, energizing the starter will cause damage to this ground contact in the ignition switch.

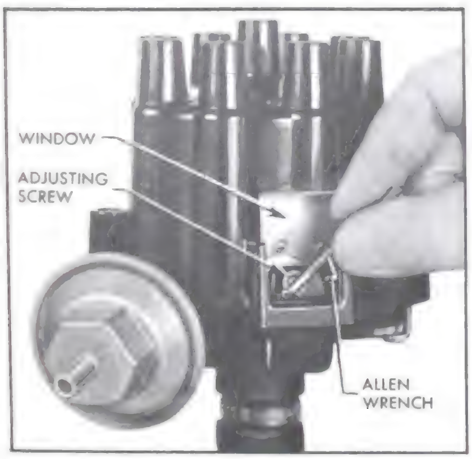


Figure 10-41—Adjusting Contact Point Dwell Angle

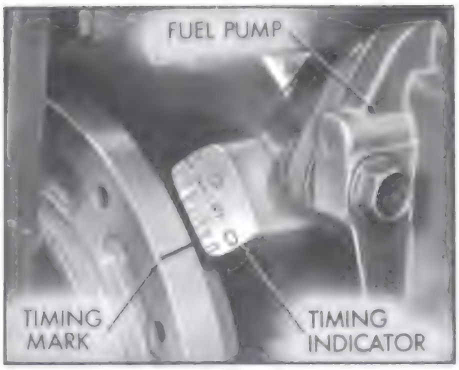


Figure 10-42—Ignition Timing Mark and Indicator-300 Engine

To time the ignition on any engine which will run, use subparagraph b only. However, if the timing of an engine is completely off, the following procedure must first be used to get the engine to run.

1. With rocker arm cover for No. 1 cylinder removed, rotate crankshaft in a forward direction using a suitable wrench on the harmonic balancer to crankshaft bolt. Continue rotation until both valves for No. 1 cylinder are completely closed and the timing mark on balancer is aligned with the proper mark on timing indicator. See Figure 10-42 or 10-43. No. 1 cylinder is now in position to fire.

Figure 10-43—Ignition Timing Mark and Indicator-401 and 425 Engines

Figure 10-44—Installing Distributor in 300 Engine

2. Install distributor in engine with rotor in position to fire No. 1 cylinder and with vacuum control in position to connect vacuum hose. See Figure 10-44 or 10-45. Install distributor clamp and bolt with lock washer, leaving bolt just loose enough to permit movement of distributor with heavy hand pressure. NOTE: If distributor does not seat in engine block, press down lightly on distributor

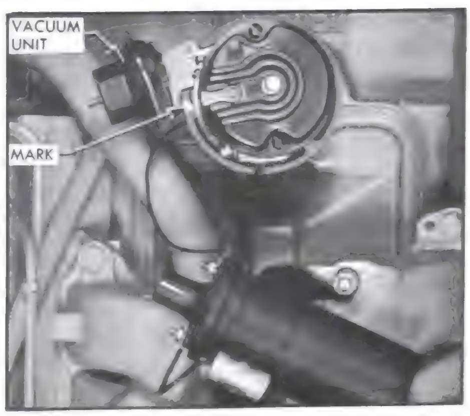


Figure 10-45—Installing Distributor in 401 and 425 Engines

Figure 10-46—Installing Spark Plug Wires in Cap-300 Engine

housing while cranking engine with starter. After distributor tang snaps into slot in oil pump shaft, start timing again from Step 1, leaving distributor installed.

3. Connect primary wire to coil.

4. Rotate distributor counter-clockwise slightly until contact points just start to open.

CAUTION: This must be done very carefully or engine will not start.

5. Install distributor cap. Make sure that spark plug wires are correctly installed in distributor cap, through clips on rocker arm covers, and on spark plugs. See Figure 10-46 or 10-47.

b. Finish Timing (Engine Running)

Contact point dwell angle should always be checked before adjusting ignition timing.

1. Connect a 12-volt power timing light to No. 1 spark plug, using a suitable adapter and following the instructions of the instrument manufacturer. CAUTION: Be careful not to puncture wire or boot as this would start a high voltage leak.

2. Connect a tachometer from distributor terminal of coil to ground.

3. Start engine and adjust contact point dwell angle to 30 degrees. While engine is warming up, make certain that spark plug wires are pushed all the way down into the distributor cap terminals and onto the spark plugs. Nipples must be pushed firmly over the terminals and boots over the spark plugs.

4. When engine temperature is normal, adjust engine idle speed and mixture. See paragraph 3-8.

5. Check idle stator switch setting and adjust if necessary. See paragraph 3-9.

6. Disconnect vacuum hose.

7. Direct beam of timing light on the timing indicator and edge of harmonic balancer. Turn distributor slowly until yellow mark on balancer is halfway between the "0" and "5" degree marks on timing indicator. (Dual 4-barrel cars with automatic transmission are timed at 12 degrees.) Tighten clamp bolt securely. See Figure 10-

8. Recheck timing mark.

9. Reconnect vacuum hose and recheck idle.

10-36 SPARK PLUG AND WIRE SERVICE

a. Remove and Inspect Spark Plugs and Wires

1. To disconnect wires, pull only on boot because pulling on wire might cause separation of the core of the wire. Remove spark plugs and gaskets using a 13/16" deep socket wrench. Use care in this operation to avoid cracking spark plug insulators.

2. Carefully inspect the insulators and electrodes of all spark plugs. Replace any spark plug which has a cracked or broken insulator, or which has loose electrodes. If the insulator is worn away around the center electrode, or the electrodes are burned or worn, the spark plug is worn out and should be discarded. Spark plugs which are in good condition except for carbon or oxide deposits should be thoroughly cleaned and adjusted.

3. The spark plug wires are of a special resistance type. The core is carbon-impregnated linen. This wire is designed to eliminate radio and television interference radiation, but is also superior in resistance to cross-fire. The resistance type wire, however, is more easily damaged than copper core wire. For this reason care must be taken that the spark plug wires are removed by pulling on the spark plug boots rather than on the wire insulation. Also, when it is necessary to replace a spark plug boot, the old boot should be carefully cut from the wire and a small amount of silicone lubricant used to aid in installing the new boot. If the wire is stretched, the core may be broken with no evidence of damage on the outer insulation. The terminal may also pull off the wire. If the core is broken, it will cause missing. In the case of wire damage, it is necessary to replace the complete wire assembly as a satisfactory repair cannot be made.

4. Wipe ignition wires with cloth moistened with kerosene, and wipe dry. Bend wires to check for brittle, cracked, or loose insulation. Defective insulation will permit missing or cross-firing of engine, therefore defective wires should be replaced.

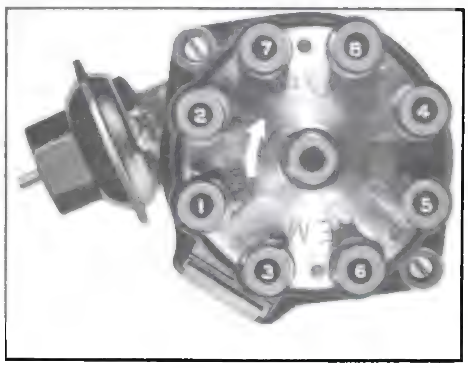


Figure 10-47—Installing Spark Plug Wires in Cap-401 and 425 Engines

5. If the wires are in good condition, clean any terminals that are corroded and replace any terminals that are broken or distorted. Replace any broken or deteriorated cable nipples or spark plug boots.

b. Spark Plug Cleaning

Spark plugs which have carbon or oxide deposits should be cleaned in a blast type spark plug cleaner. Scraping with a pointed tool will not properly remove the deposits and may damage the insulator. If spark plugs have a wet or oily deposit dip them in a degreasing solvent and then dry thoroughly with dry compressed air. Oily plugs will cause the cleaning compound to pack in the shell.

Carefully follow the instructions of the manufacturer of the cleaner being used, cleaning each plug until the interior of shell and the entire insulator are clean; however, avoid excessive blasting.

Examine interior of plug in good light. Remove any cleaning compound with compressed air. If traces of carbon or oxide remain in plug, finish the cleaning with a light blasting operation. Clean firing surfaces of center and side electrodes with several strokes of a fine file.

When spark plugs have been thoroughly cleaned, carefully inspect for cracks or other defects which may not have been visible before cleaning.

c. Adjusting Spark Plug Gap

Use round wire feeler gauges to check the gap between spark plug electrodes. Flat feeler gauges will not give a correct measurement if the electrodes are worn. Adjust gap by bending the side electrodes only; bending the center electrode will crack the insulator. Adjust gaps to .035". Setting spark plug gap to any other specification to improve idle or effect other changes in engine performance is not recommended.

d. Installation of Spark Plugs

For normal operation, use AC Type 44S spark plugs in 401 and 425 engines or 44FFS spark plugs in 300 engines. For cars operated mainly at high speeds, the colder AC Type 42 Commercial spark plugs are recommended in 401 and 425 engines or 42FF in 300 engines.

Where spark plug fouling is encountered at low plug mileage in 401 and 425 engines and where the car is used mainly for low speed city driving, the hotter AC type 45S spark plug may be used.

CAUTION: High speed operation or frequent full throttle acceleration with 45S spark plugs may result in damaged pistons.

When installing spark plugs make sure that gaskets are in good condition to insure a tight seal and that all surfaces on plugs and in cylinder heads are clean. Install spark plugs, then tighten them to 30 ft. lbs. torque in 401 and 425 engines or 20 ft. lbs. in 300 engines, using a 13/16" socket, an extension, and a torque wrench. If a torque wrench is not available, do not tighten plugs excessively.

e. Installation of Spark Plug Wires

Spark plug wires must be arranged to pass through the wire clips on the rocker arm covers in the same order as they are attached to the spark plugs. If spark plug wires are not correctly installed, missing or crossfiring may result. For instance, No. 1 and 3 cylinders may crossfire (since they fire consecutively) unless the rubber grommet is inserted in the clip so that No. 1 and 3 wires are separated.

No. 1 spark plug wire is installed in the distributor cap terminal just forward of the vacuum advance unit. The other wires are then installed in a clockwise direction according to the firing order. See Figure 10-46 or 10-47.

10-37 IGNITION COIL TESTS

a. Weak Coils

Most ignition coils that are replaced by service stations are classified by them as weak. Many coils rejected as weak actually test up to specifications and give normal performance.

A coil that actually is weak will first affect engine performance when the ignition reserve is at a minimum. This may be in starting, low speed acceleration or top speed. Eventually the engine will fail to start.

High resistance connections in either the primary or secondary circuit wiring will react the same as a weak coil. Wide spark plug gaps, which require higher voltage than the coil can produce, put the coil under suspicion. High compression and lean carburetor increase the voltage requirements and lead to many needless coil changes. Leakage of high tension current through moisture on an unprotected coil terminal may produce carbon tracks which weaken the coil output voltage. For this reason the nipple on coil high tension terminal must be properly installed and in good condition.

When an ignition coil is suspected of being defective it should be tested as described below before being replaced.

b. Testing Coil for Open and Grounded Circuits

Before using a coil test instrument, the coil should be tested for open and grounded circuits,

using a 110-volt test lamp and test points.

1. Apply test points to both primary terminals of coil. If test lamp does not light, the primary circuit is open.

2. Apply one test point to the high tension terminal, and the other test point to one of the primary terminals. If secondary circuit is not open, the lamp will not light but tiny sparks will appear at test points when they are rubbed over terminals. If secondary circuit is open, no sparks will occur.

3. Apply one test point to a clean spot on the metal coil case and touch the other point to the primary and high tension terminals. If the lamp lights, or tiny sparks appear at the points of contact, the coil windings are grounded.

4. A coil with open or grounded windings must be replaced since internal repairs cannot be made. It is unnecessary to test such a coil with instruments. If windings are not open or grounded, a test for short circuits and other internal defects should be made with a reliable coil test instrument.

c. Coil Test Instruments

Two general types of instruments are used in testing ignition coils. One type makes use of an open or protected spark gap, while the other reports the condition of the coil on a meter.

The spark gap type of tester should always be used comparatively, that is, the questionable coil should be compared with a coil of same model that is known to be good. Both coils must be at the same temperature and identical test leads must be used. Certain variables caused by altitude, atmospheric or spark gap electrode conditions are usually present in the spark gap type of test.

The meter type testers are usually designed to permit testing the coil without making any connection to the secondary terminal. This eliminates the variables usually present in the spark type of test and avoids the necessity for comparison with a good coil.

Since different makes and models of coil testers differ in their methods of use, as well as in the markings on meters, the instructions of the manufacturer must be carefully followed when using any coil tester. The instrument must be frequently checked to make certain that it is accurately calibrated.

Regardless of instrument or method used, the coil must be tested at normal operating temperature because internal defects often fail to show up on a cold test.

10-38 DISTRIBUTOR CONDENSER TESTS

When a condenser is suspected of being faulty it should be tested with a reliable condenser tester to determine whether it is actually the cause of ignition trouble. The condenser should be tested for (a) high series resistance (b) insufficient or excessive capacity (c) low insulation resistance.

A special condenser tester is required to make these tests. When using a condenser tester the instructions of the manufacturer must be carefully followed. IMPORTANT: The condenser must be at normal operating temperature when it is being tested.

a. High Series Resistance

High series resistance in the condenser causes condenser to be slow in taking the charge and, consequently, a higher than normal voltage is developed across the contact points when they first start to open. This higher voltage causes more disturbance at the contact points, which in turn causes more rapid wear and more tendency toward oxidized surfaces. The condition can become severe enough to cause complete failure of the ignition system. It would first show up during starting and low speed operation.

High series resistance may be caused by internal resistance in condenser or by resistance in the connections. Any defect caused by internal resistance should show up at low mileage since this does not change very much with time or use. The damaging changes are in the connections, in which looseness, corrosion, or broken strands may develop.

New condensers may have a series resistance as low as .05 ohm. Some condenser testers are set to reject condensers which have a resistance of .3 ohm; however, tests show that the resistance can go to .5 ohm before ignition performance is affected.

b. Insufficient or Excessive Capacity

The condenser specified for use in the Buick ignition system has a capacity of .18 to .23 microfarads.

If a condenser is used which does not have the specified capacity of .18 to .23 microfarads, excessive pitting of one contact point and a corresponding build-up of metal on the other contact point will result. A condenser having insufficient capacity will cause build-up of metal on the breaker arm (positive) point. A condenser having excessive capacity will cause build-up of metal on the contact support (negative) point.

In exceptional cases, pitting and metal buildup on contact points may be experienced even when condenser capacity is within the specified limits. In such cases

the life of contact points will be improved by installing a condenser of high-limit capacity if metal build-up is on breaker arm point, or a condenser of low-limit capacity if metal build-up is on contact support point. There is usually sufficient variation in the capacities of stock condensers to permit selection of a high or low limit condenser by testing the available stock.

c. Low Insulation Resistance

A weak or leaking condenser is usually one that has absorbed water so that the insulation resistance of the winding is lowered to the extent that the condenser will not hold a charge satisfactorily. A condenser with low insulation resistance will drain sufficient energy from the ignition system to lower the secondary voltage seriously. The condenser specified for use in the Buick ignition system is sealed to prevent absorption of water, and nc other type should be used.

A leaky condenser usually does not affect engine performance except when hot. It is unlikely that a condenser with low insulation resistance would cause missing at low or medium speeds under conditions where the condenser does not get hot. A condenser that has low enough resistance to affect engine performance when cold would probably be indicated as broken down on most condenser testers.

Condenser testers equipped to check condensers for low insulation resistance usually give a reading in megohms, a megohm being one million ohms. The scale is marked to indicate whether the condenser is good or bad.

When testing a condenser for low insulation resistance the lead should always be disconnected from the distributor. Since the distributor terminals and the connected circuit have much lower insulation resistance than the condenser, failure to disconnect the condenser lead will give a reading much too low.

10-39 DISTRIBUTOR SERVICE OPERATIONS

a. Removal and Disassembly of Distributor for Inspection

1. Disconnect the distributor primary wire from coil and disconnect hose from vacuum unit. Remove distributor cap by inserting a screwdriver in upper slotted end of cap latches; then press down and turn 90° counterclockwise.

2. Make a mark on distributor base in line with center of rotor. Then carefully note the direction the vacuum unit points in relation to the engine so that the distributor can be replaced in the exact same position after it is serviced. See Figure 10-44 or 10-45.

CAUTION: If engine is turned over while distributor is out, complete ignition timing procedure must be followed (par. 10-33).

3. Remove distributor clamp and lift distributor out of crankcase.

4. Remove rotor from end of distributor shaft by removing two attaching screws and lock washers.

5. Remove contact point set and condenser as described in paragraph 10-34.

6. Remove two screws holding vacuum advance unit to housing. Remove advance unit.

7. Remove "O" ring seal from shaft housing.

b. Inspection of Distributor Parts

1. Wash the distributor assembly in clean solvent, holding housing horizontal to avoid getting cleaning solvent into the lubricant reservoir. Dry parts thoroughly.

2. Cap. Wipe out distributor cap with a clean cloth and inspect it for chips, cracks, and carbonized paths which would allow high-tension leakage to ground. Such defects require replacement of cap. Clean loose corrosion from surfaces of terminal segments inside the cap. Do not use emery cloth or sand paper. If segments are deeply grooved, the cap should be replaced. Pull cables from terminal sockets and inspect sockets for corrosion. Clean sockets, using a stiff wire brush to loosen corrosion.

3. Rotor. If rotor is cracked, spring contact is badly worn, or rotor tip is badly burned, rotor must be replaced.

4. Condenser. Inspect condenser and primary leads for loose or frayed terminal connections. Check condenser in a reliable condenser tester as described in paragraph 10-38.

5. Vacuum Advance Unit. Inspect rod end for excessive wear. Push rod into unit as far as possible, hold finger tightly over nipple and then release rod. After about 15 seconds, release finger from hole and notice if air is drawn in. If not, diaphragm is leaking and unit must be replaced.

6. Contact Ponts. Carefully examine the mating surfaces of the contact points, noting whether they are flat and making good contact, or whether they are blackened, pitted, burned, or worn excessively. Contact points which have been in service for some time will appear dull and gray. This condition is normal and such points should not be replaced.

Contact points which are blackened or only slightly burned or pitted may be cleaned with a thin contact stone or a clean fine-cut contact file. Remove high points only; it is not necessary to remove

all buildup or pit. CAUTION: Do not use emery cloth or sandpaper to clean contact points because particles of these materials usually embed in contact surfaces and cause points to burn.

Excessively burned, pitted or worn contact points cannot be cleaned up and aligned satisfactorily; therefore, they must be replaced to insure satisfactory ignition (par. 10-34).

If contact points are excessively burned, pitted, or blackened it is advisable to check for cause and make the necessary correction so that new points will give satisfactory service. Burned or pitted points may be caused by:

(a) Ignition coil resistance unit not properly connected into circuit. Connect between ignition switch and coil positive (+) terminal.

(b) Defective condenser. Test the condenser (par. 10.38).

(c) Insufficient contact point opening. Adjust contact point dwell as described in paragraph 10-34 (c).

(d) Oil vapors getting into the distributor and depositing on contact surfaces of points. This causes arcing and rapid burning of contact points. Oil vapor entering distributor usually produces a smudgy line under the points.

(e) High voltage, or any other condition in electrical system causing excessive through contact points. This results in a blue scale forming on point surfaces. Check condenser for high series resistance (par. 10-38). Check voltage and current regulator (par. 10-26).

(f) Radio capacitor connected to distributor terminal. This will cause excessive pitting of contact points. Capacitor should be connected to the positive (battery) terminal of coil.

7. If any remaining parts are defective, the distributor must be completely disassembled to replace them. Before disassembling distributor further, inspect parts as follows:

(a) Centrifugal Advance. Inspect for excessive wear between centrifugal weights and advance cam, or pivot pins. Turn weight base plate in a clockwise direction until weights are fully extended, then release and allow springs to return weights to retard position. Repeat several times. Springs should return weights to stop without sticking and there should be no excess free movement in the retard position.

(b) Cam and Weight Base Plate. Inspect cam lobes for scoring or excessive wear. Check weight base plate for bind or excessive looseness on distributor shaft.

(c) Breaker Plate. Attempt to rotate plate to check for excess free motion between plate and vacuum advance unit linkage. Check plate for excess looseness on O.D. of upper distributor shaft bushing. Check breaker plate ground lead for poor spot-weld at plate end or for loose or frayed terminal connections.

(d) Distributor Shaft. Check for excessive wear between shaft and bushings in housing.

(e) Driven Gear. Inspect gear for scoring of teeth or excessive wear.

8. To replace any part found to be defective in Step 7, the distributor must be completely disassembled as follows:

(a) Drive out driven gear pin using a hammer and a 1/8" straight punch. See Figure 10-48. CAUTION: Be careful not to bend distributor shaft or damage gear when driving pin out.

(b) Slide gear off shaft and then pull the shaft, breaker cam, and centrifugal advance mechanism from the housing.

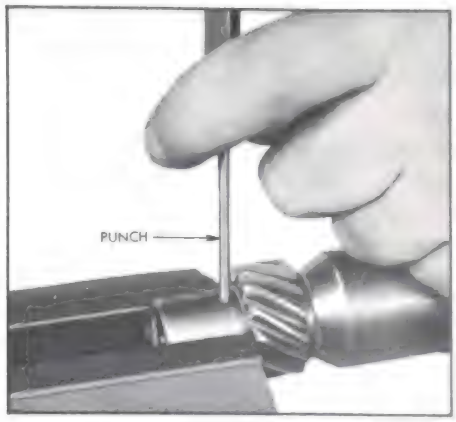


Figure 10-48—Removing Distributor Gear Pin

(c) Remove two advance weight springs and weights. Slide the integral weight base plate and breaker cam off the lower end of shaft.

(d) Remove retainer from upper bushing and lift breaker plate and felt washer from upper bushing.

(e) Remove distributor primary lead and grommet from housing. NOTE: No attempt should be made to replace the shaft bushings in the housing as the housing and bushings are only serviced as an assembly.

c. Assembly and Installation of Distributor

NOTE: The first five steps apply only if the distributor has been completely disassembled.

1. Install distributor primary lead and rubber grommet. Install vacuum advance unit with ground lead terminal from breaker plate under outer mounting screw and lock washer. See Figure 10-40.

2. Install felt washer over upper bushing and apply a few drops of light oil. Then place breaker plate over upper bushing and vacuum advance link. Install retainer on upper bushing. See Figure 10-49.

3. Slide distributor cam and weight base plate on distributor shaft.

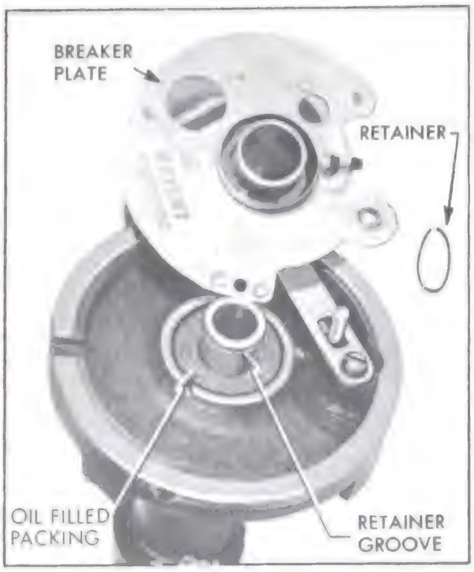


Figure 10-49—Installing Breaker Plate and Retainer

4. Install distributor shaft and breaker cam assembly in housing. Install advance weights and springs.

5. Slide driven gear on shaft. Drive roll pin through gear and shaft. Be careful not to damage gear.

6. Place condenser and bracket over bosses on breaker plate and secure with screw.

7. Place contact point set over boss on breaker plate and secure with two screws and lock washers. Apply one drop of light oil to breaker arm pivot. Then install condenser and primary leads.

8. Work a small amount of high temperature cam and ball bearing lubricant (available through U.M.S.) into a clean cloth, then hold cloth against distributor cam while turning distributor shaft. CAUTION: Excessive grease may throw off into contact points when hot. Petroleum jelly is not suitable for temperature reached by the cam.

9. Make the preliminary contact point adjustment (par. 10-34, b).

10. Install rotor and secure with two screws, lock washers, and plain washers. NOTE: The square and round lugs on the bottom of the rotor must be positioned in the corresponding holes in the weight base plate. See Figure 10-52.

11. If a reliable distributor tester is available, check the distributor to make certain that the centrifugal and vacuum advance mechanisms are operating according to the specifications given in paragraph 10-4 (c). NOTE: Mount distributor in tester with all end-play of the distributor shaft in the up position; this is to eliminate any possible drag between the centrifugal advance cam and weight base plate.

12. Install new "O" ring seal on distributor housing.

13. Insert distributor in engine block so that rotor is pointing to mark made on distributor base, with vacuum advance unit pointing in exact original direction. Connect vacuum pipe to advance unit.

14. Install distributor clamp and bolt with lock washer, leaving bolt just loose enough to permit movement of the distributor with heavy hand pressure.

15. Connect primary wire to distributor side of coil. Install distributor cap.

16. If spark wires were removed, make certain that they are replaced as shown in Figures 10-46 or 10-47. Wires must be pushed all the way down into the distributor cap terminals and onto the spark plugs. Nipples must be pushed firmly over the terminals and boots over the spark plugs.

17. Start engine and adjust contact point dwell angel (par. 10-34, c). Then adjust ignition timing (par. 10-35, b). NOTE: If engine was accidentally turned over while distributor was out, complete ignition timing procedure must be followed (par. 10-35, a & b).

10-40 IGNITION SWITCH AND LOCK REPAIRS

a. Ignition Switch Key

If ignition key sticks or feels rough as it is inserted into the lock, examine it for burrs and smooth up with a fine cut file. Blow finely powered graphite into lock cylinder, then work key in and out of cylinder a number of times to work graphite into tumblers. Do not use oil in lock cylinder as this will cause tumblers to stick.

If ignition switch key is lost and key code number is not known, the code number will be found stamped on the glove box lock cylinder, which must be removed. A new key can be cut by using this code number.

b. Lock Cylinder Replacement

To remove lock cylinder, insert key and turn ignition switch to "ACC." position. Insert a stiff wire (paper clip) in small hole in face of cylinder to depress the pin which locks the cylinder, turn cylinder counterclockwise and pull out. To install lock cylinder

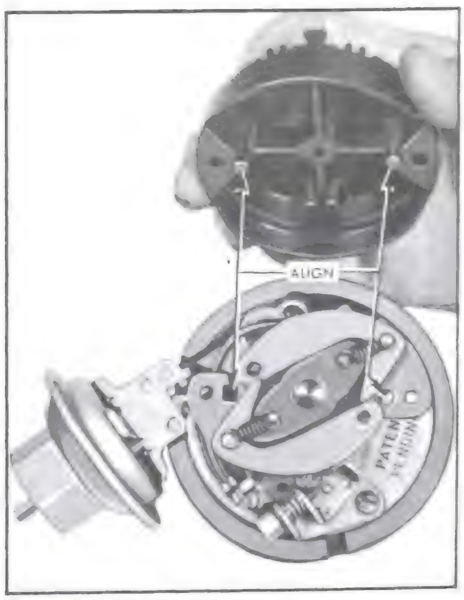


Figure 10-50—Installing Rotor

insert key, place cylinder in switch slightly counterclockwise from "ACC." position, press inward and turn cylinder clockwise. See Figure 10-51.

c. Ignition Switch Replacement

1. Disconnect battery ground cable to avoid a possible short circuit.

2. Remove lock cylinder (subpar. b).

3. Remove right access door retaining screws and remove door from instrument panel.

4. Remove ignition switch nut with Wrench J-8562.

5. Unplug wiring connector from switch.

6. Install switch by reversing above procedure.

d. Removal of Lock Cylinder Which Cannot be Unlocked with Key

When ignition switch fails to unlock with the proper key, and lock has previously been operating satisfactorily, the lock cylinder can be removed as follows:

Figure 10-51—Ignition Switch

1. Draw a centerline on cylinder at 90° to left side of key slot, insert key, and make a prick punch mark on centerline 3/8" from side of key. Carefully drill a .0465 hole (No. 56 drill) through cylinder flange at this point.

2. File the end of a stiff wire (paper clip) to a taper. Insert this end of wire in drilled hole to pry the cage bar assembly down so that lock cylinder can be turned. After turning cylinder slightly, remove the wire to avoid wedging, then remove lock cylinder in the regular manner (subpar. b, above).

3. Stake cage bar in place at four points. Staking must not distort cage. Reinstall lock cylinder and check operation with key. If operation is satisfactory, plug the drilled hole with a small pin No. 00 x 1/8" (Parker Kalon type "U").

SECTION 10-F

LIGHTING SYSTEM

CONTENTS OF SECTION 10-F

10-41 HEADLIGHTS AND CONTROLS

a. Description of Lighting Switch

The switch uses a multiple push-on type connector. It is a "push-pull" type which also incorporates a manually operated rheostat for controlling the instrument panel lights, and a detent position which completes the dome light circuit. Three "push-pull" positions of the switch knob provide control of the exterior lights as follows:

1. Off position (knob all the way in) cuts off all lights controlled by the switch.

2. Parking position (knob pulled out to first notch) turns on the parking lights, tail lights, and license light and key light. The instrument panel lights also will be turned on if the rheostat is set for these lights.

3. Driving position (knob pulled out to last notch) turns parking lights off and turns headlights on, while the other lights remain as in the parking position. The headlights will be on the upper or lower beams depending on the position of the separate dimmer switch.

In the parking and driving positions, the instrument panel lights are controlled by rotating the light switch knob. With the knob turned counterclockwise, these lights are on maximum brightness. As the knob is turned clockwise, they gradually dim until they are off at the full clockwise position of the knob.

4. Dome light position (knob turned fully counterclockwise) turns the dome light on. The dome light can be turned on regardless of the in-or-out position of the switch.

b. Description of Thermo Circuit Breaker

A thermo circuit breaker is incorporated in the lighting switch assembly, to protect wiring from damage due to short circuits in the headlight and front parking light circuits only.

The thermo circuit breaker consists of a bi-metal blade and set of contact points connected in series with the lighting circuits. An abnormal flow of current through the circuit breaker, such as would be caused by a short circuit in a lighting circuit, heats the bi-metal blade sufficiently to separate the points and cause them to vibrate. The vibrating blade alternately opens and closes the circuit, thus reducing the flow of current and protecting the wiring against overheating and burning. The flickering light produced by the vibrating circuit breaker serves as a warning to the operator of vehicle that a short circuit exists.

c. Test of Lighting Switch

If the lighting switch is suspected of being faulty, the contacts can be tested by connecting a low reading voltmeter between the wire supplying current to the contact and the wire conducting current away. This must be done with the switch in a position where the contact under test is closed. See Figure 10-52.

1. In order to gain access to the headlight switch, remove the screws that retain the left access door to the instrument panel and remove the door.

2. To check the switch contact for the headlights, pull switch knob out to last notch and also make sure dimmer switch is in upper beam position. Connect voltmeter prods between battery and headlight terminals of switch (between red and light blue wires).

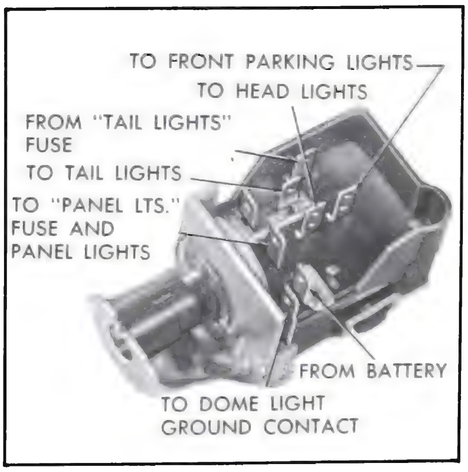


Figure 10-52—Lighting Switch-Bottom Side

If voltage loss through switch contacts is over .2 volt, switch must be replaced.

3. To check the contact for the tail lights, connect voltmeter between tail lights and tail light fuse terminals (between two brown wires). If voltage loss is over .1 volt, switch must be replaced.

4. To check the contact for the front parking lights, put switch knob in first notch position. Connect voltmeter between battery and parking light terminals (between red and purple wires). If voltage loss is over .1 volt, switch must be replaced.

d. Replacement of Lighting Switch

1. Disconnect battery to ground cable to avoid a possible short circuit.

2. Remove screws that retain left access door to instrument panel and remove door.

3. Pull switch knob out to last notch, then depress the spring loaded latch button on top of switch, while pulling knob and rod assembly out of switch.

NOTE: If latch button is depressed before switch knob is pulled out, knob and rod assembly will not release.

4. Remove switch escutcheon with Wrench J-21233. Remove switch from cluster assembly. See Figure 10-78.

5. Unplug multiple connector from lighting switch.

6. Install switch in reverse order of above steps, making sure that switch alingment tang engages slot in cluster and ground plate before tightening escutcheon.

7. Reconnect battery ground cable.

e. Test of Light Switch Thermo Circuit Breaker

To test the thermo circuit breaker, remove lighting switch from instrument panel to avoid possible damage to adjacent instruments.

Since the current required to open the circuit breaker contacts depends somewhat on outside temperature, the circuit breaker should be tested at normal temperature (70° to 80°F.).

1. Connect an ammeter and a carbon-pile rheostat in series with the battery terminal of lighting switch and positive terminal of a 12-volt battery, and set rheostat to provide maximum resistance. Rheostat must have capacity for 50 amperes and be adjustable down to .3 ohms.

2. With switch on connect the headlight terminal of lighting switch and the negative post of battery.

3. Adjust rheostat to give 26 amperes. The circuit breaker should open within 60 seconds.

4. Adjust rheostat to give 15 amperes on ammeter. The circuit breaker should remain closed indefinitely at 15 amperes.

5. If circuit breaker does not operate as specified the lighting switch assembly must be replaced since internal repairs cannot be made.

f. Dual Headlamp Assembly

A dual headlamp system is standare equipment on all series and consists of two dual headlamp assemblies, one mounted on each side of the car.

Each dual headlamp includes two 5 3/4" T-3 sealed beam units mounted in a single housing enclosed by one headlamp door. The inboard unit is used for bright lights only and has a single filament. The outboard unit is used for both bright and dim lights and has two filaments. For identification, the inborad unit is marked "1", the outboard unit is marked "2".

When the dimmer switch is in the dim or lower beam position only, the outboard unit of each dual headlamp is on. Both outboard and inboard units of each headlamp are on when the dimmer switch is in the bright or high beam position.

The T-3 sealed beam unit has three projections equally spaced around the perimeter of the lens. These projections are ground off at the factory to provide a mounting surface for aiming devices. These aiming devices are used without having headlights on as described below.

g. Dimmer Switch

The driver may select the upper or lower headlight beam as traffic and road conditions demand by operating the dimmer switch mounted on the toe panel in a convenient position for the left foot.

The dimmer switch opens and closes the circuits to the upper and lower lamp filaments in the sealed beam units, thereby alternately raising and lowering the headlight beams with each successive operation of the switch. Depression of switch button turns the rotary contacts one position within the switch. The spring-loaded button automatically returns to the reset position when released.

The wiring connection to the dimmer switch is made by a multiple connector. The dimmer switch is mounted on the inner side of the toe pan, so the switch, connector and wiring are all inside the car.

h. Headlight Beam Indicator

Whenever the upper headlight

beams are lighted, a beam indicator bulb in the instrument cluster also lights, producing a small spot of red light in front of the driver. See Figure 10-65. For safety reasons, never pass an approaching car with the beam indicator showing red.

10-42 HEADLAMP SEALED BEAM UNIT REPLACEMENT AND ADJUSTMENT

a. Replacement of Sealed Beam Unit

1. Remove headlamp door by removing four retaining screws.

2. Unhook the spring from retaining ring, then remove sealed beam unit and retaining ring, being careful not to disturb the two beam adjusting screws.

3. Install new sealed beam unit by reversing removal procedure. Position lens with the "1" or "2" up. The unit has three lugs which fit into notches in the headlamp mounting ring.

CAUTION: Make sure that sealed beam unit is marked "1" for an inboard unit or "2" for an outboard unit.

4. Before installation of headlamp door, adjust headlamp for proper aim as described below.

b. Headlamp Aiming

The headlamps must be properly aimed in order to obtain maximum road illumination and safety that has been built into the headlighting equipment. With the Guide T-3 type sealed beam units, proper aiming is even more important because the increased range and power of this lamp make even slight variations from recommended aiming hazardous to approaching motorists. The headlamps must be checked for proper aim whenever a sealed beam unit is replaced and after any adjustment or repairs of the front end sheet metal assembly.

Regardless of method used for checking headlamp aim, car must be at normal weight, that is, with gas, oil, water, and spare tire. Tires must be uniformly inflated to specified pressure (par. 1-1). If car will regularly carry an unusual load in rear compartment, or a trailer, these loads should be on car when headlamps are checked. Some states have special requirements for headlamp aiming adjustment and these requirements should be known and observed.

Horizontal and vertical aiming of each seal beam unit is provided by two adjusting screws which move the mounting ring in the body against the tension of the coil spring. There is no adjustment for focus since the sealed beam unit is set for proper focus during manufacturing assembly.

10-43 PARKING, TAIL, STOP, LICENSE, BACK-UP AND TRUNK LIGHTS

NOTE: See paragraph 10-5 for lamp bulb and fuse specifications.

a. Front Parking and Signal Lights

Each front parking and signal lamp contains one 32-4 CP lamp bulb which provides a 4 CP parking light and a separate 32 CP direction signal light. The pins on lamp bulb and slots in socket are offset to prevent improper installation of bulb in socket. The parking light is controlled by the lighting switch and the circuit is protected by the switch thermo circuit breaker. The turn signal light is separately controlled by the signal switch and the circuit is protected by 10 ampere "DIR. SIG." fuse on the fuse block under the instrument panel. All front turn signal bulbs are amber in color.

Rivieras have a separate single filament 4CP parking lamp bulb in each headlight assembly.

b. Tail, Stop, and Signal Lights

Each rear lamp assembly contains a 32-4 CP bulb which is used as a combination tail, stop, and direction signal light. The tail lights are controlled by the lighting switch and the circuit is protected by the 10 ampere "TAIL" fuse on the fuse block.

The stop lights are controlled by a mechanical switch mounted on the brake pedal bracket. This spring loaded switch makes contact whenever the brake pedal is applied. When the brake pedal is released, it depresses the switch to open the contacts and turn the brake lights off.

The direction signal switch is in the circuit, so the stop lights may be flashing or constant depending on the position of the switch. The direction signal and stop light circuit is protected by the 10 ampere "DIR. SIG." fuse mounted on the fuse block.

The combination tail, stop, and directional signal lamp sockets can be snapped out from inside the trunk compartment. Since the position of the bulb filaments is important in the rear lamps, these sockets have been provided with a tongue and groove index to insure correct positioning.

c. Rear License Lights

The rear license lamp is mounted above the license plate to provide adequate lighting of the plate. The lamp contains one 4 CP lamp

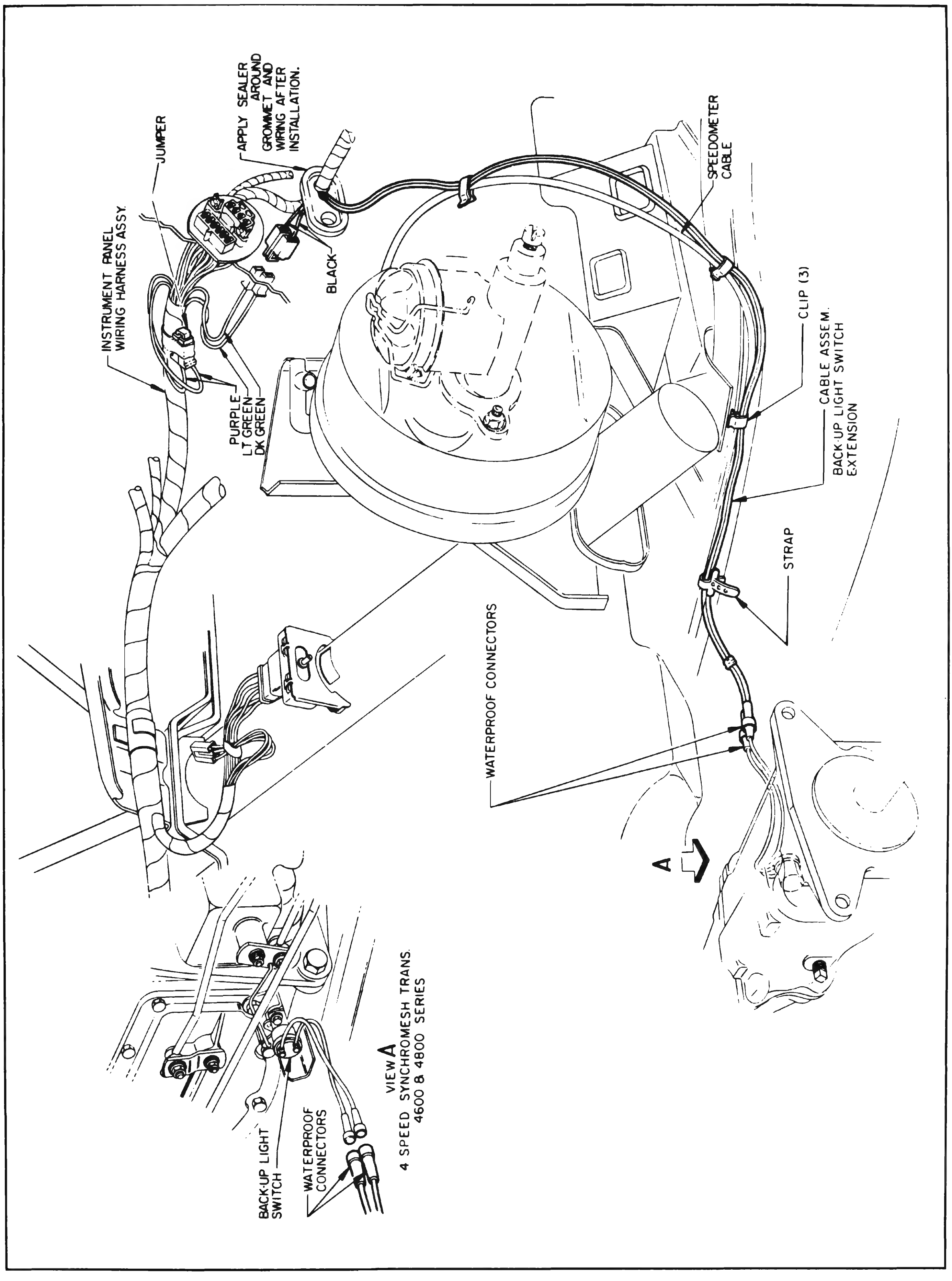


Figure 10-53—Back-Up Light Switch Wiring - 4 Speed Transmission

bulb which operates in conjunction with the tail lights, and its circuit is also protected by the 10 ampere "TAIL LTS." fuse on the fuse block.

The lamp bulb may be replaced by removing the lamp lens.

d. Back-up Lamps and Switch

Back-up lamps are located in the rear body panel. See Figure 10-153. They contain 32 CP bulbs behind clear plastic lenses.

The back-up light switch is combined with the neutral safety switch. It is mounted on the steering column jacket under the instrument panel. The switch is actuated by a lever on the transmission control shaft which projects through a slot in the jacket. When the neutral safety portion of the switch is correctly timed, the back-up portion is properly timed automatically. Slotted mounting screw holes permit sidewise movement of the switch for proper timing. See subparagraph e for the adjusting procedure for the neutral safety and back-up light switch. The back-up light circuit is protected by the 10 ampere "BACK-UP" fuse on the fuse block.

e. Neutral Safety Switch Adjustment

Check and adjust neutral safety switch as follows:

1. Check shift control linkage and adjust if necessary.

2. Place shift control lever in Park position.

3. Insert a 3/32" drill or a piece of 3/32" drill rod through gauging hole in operating lever and through gauging hole in switch body. See Figure 10-54.

4. If gauging drill or drill rod is now parallel with centerline of steering column jacket, neutral safety switch timing is OK. If gauging drill will not go through holes or is not parallel, loosen two switch mounting screws and move switch sidewise until gauge is parallel. Then retighten screws.

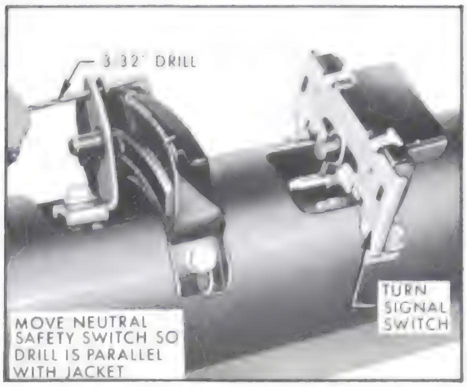


Figure 10-54—Checking Neutral Safety Switch Adjustment

5. To recheck adjustment, turn on ignition switch, place shift control lever in reverse, and make sure back-up lights are lit. Set parking brake, place shift lever in Neutral and make sure engine will start. Then place shift lever in Park and try starting engine again. Engine must not start in Drive or Reverse.

10-44 INTERIOR LIGHTS AND CIGAR LIGHTERS

NOTE: See paragraph 10-5 for lamp bulb and fuse specifications.

a. Instrument Panel Lights

The speedometer, heater-defroster controls, ventilation or air conditioner controls, transmission control dial, ignition switch key slot, clock and ash tray are illuminated by lamp bulbs mounted to provide indirect lighting.

The instrument panel lights are controlled by the lighting switch as described in paragraph 10-41 and the circuits are protected by the 3 ampere "PANEL LTS." fuse on the fuse block.

To replace an instrument cluster bulb, remove the socket and bulb assembly from the instrument cluster by rotating counterclockwise. Replace the bulb and reinstall the assembly by rotating it clockwise. See Figure 10-69 for the location of instrument cluster bulbs.

b. Instrument Panel Compartment Light

The instrument panel compartment (glove box) is lighted by a lamp bulb mounted in a socket in the upper center of the glove box. The switch is mounted separately in the door opening. This spring-loaded switch makes contact when the compartment door is opened. As the door is closed it depresses the switch button to break contact and turn the light off. This circuit is protected along with the courtesy lights circuit by the 5 ampere "CRTSY." fuse on the fuse block.

c. Parking Brake Warning Light

The parking brake warning light will show a red warning "BRAKE" signal light in the instrument cluster whenever the ignition switch is turned on while the parking brake is applied. The signal lamp is controlled by a switch mounted in position to be operated by the parking brake lever. The circuit is protected by the 6 ampere "BK. & BZ." fuse on the fuse block under cowl.

When brake lever is in fully released position, the signal switch plunger must be depressed 3/16" to open the circuit. Adjustment is made by loosening the mounting screw and shifting the switch as permitted by the slotted screw hole. To replace bulb it is necessary to reach under instrument panel and pull light socket assembly from cluster.

d. Direction Signal Indicator Lights

The direction signal indicator consists of a 2 CP bulb mounted

at each end of the instrument cluster. To get a bulb out of the instrument cluster, the instrument panel control plate nearest the bulb must be removed. See Figure 10-69 for the location of indicator bulb socket.

e. Automatic Transmission Control Dial Light

The control dial in the instrument panel is illuminated by a 2 CP lamp bulb mounted in the cluster to provide indirect lighting. The light intensity is controlled by the lighting switch in the same manner as all instrument panel lights.

To replace the lamp bulb, remove the socket and bulb assembly, replace the bulb and reinstall the assembly.

f. Cigar Lighter

The cigar lighter is heated by pressing the knob in until it latches; the knob will automatically unlatch and return to "off" position when heated to proper temperature.

The lighter is equipped with an ash guard, to prevent ashes and loose tobacco from falling on the user's clothing and to permit the lighter to be passed around without danger of burning the fingers.

The Casco lighter has a replaceable thermal fuse screwed into the lighter base to protect the lighter element against over heating.

g. Courtesy Lights

The courtesy light has a 6 CP bulb located above the glove box door. See Figure 10-81. The courtesy light circuit is protected by the 5 ampere "CRTSY-GLV." fuse on the fuse block.

To replace the bulb, remove the two screws holding the courtesy lamp in position, drop the lamp and replace the bulb.

SECTION 10-G

SIGNAL SYSTEMS

CONTENTS OF SECTION 10-G

10-45 HORNS AND CONTROL CIRCUIT

a. Horns and Relay

Two Delco-Remy electrically operated vibrator type horns are mounted in the engine compartment. Both horns are operated simultaneously by a horn relay which is controlled by the horn push button on the steering wheel. One horn is high pitched and the other is low pitched, so that together they produce a pleasant blended tone.

The horn relay is an electrical switch which closes the circuit between the battery and the horns when the push button is pressed and opens the circuit when the button is released. The relay permits control of the horns with a small amount of current passing through the horn button contacts. The high current required by the horns would cause arcing and burning of these contacts.

When the horn button contacts are closed, a small amount of current flows through the relay winding to ground at the horn push button contact. This magnetizes the relay core which attracts the flat steel relay armature. The armature has a contact point which makes contact with a stationary point to close the horn circuit. When horn push button is released, current stops flowing through relay winding so that the core loses its magnetism; the armature spring then causes contact points to be separated.

b. Horn Relay Ground Circuit

The steering wheel has an actuator bar mounted across the steering wheel. Fastened to the base of the actuator bar, but insulated from it, is a contact plate which is "hot" at all times. See Figure 10-55. When the actuator bar is rocked, the contact plate contacts a ground plate on the steel hub of the steering wheel to ground the horn relay winding, close the relay contacts, and blow the horn. When the actuator bar is released, two springs move the actuator bar and contact plate assembly clear of the ground plate.

Current is supplied to the contact plate by a spring-loaded brush which rides on the contact ring located at the upper end of the steering column. A wire attached to the contact ring runs down inside the steering column jacket and out under the instrument panel. The wire from the horn relay connects at this point.

10-46 TROUBLE DIAGNOSIS AND ADJUSTMENT OF HORNS

If a horn button contact is constantly grounded, the horns will not stop blowing or if a contact cannot be grounded, the horns will not blow.

There are two basic troubles, which may be caused by a defective horn relay. If neither horn will blow at all, this trouble may be caused by the relay points not making contact. Or if horns will not stop blowing, this trouble may be caused by relay points sticking.

a. Horns Will Not Blow

When horns fail to blow, first check wiring circuit and relay because even a faulty horn will generally make some sort of noise if current is getting to it. If horns are at fault, or tone is poor, adjust each horn for specified current draw as instructed in subparagraph e.

1. Break circuit at connector for horn wire that enters steering mast jacket (tan wire) and ground wire from horn relay. If horn now blows, horn relay ground circuit in mast jacket or steering wheel has an open. Reconnect wire on connector and check horn wire and horn contacts. Circuit from connector at mast jacket to contact on steering wheel must be complete. To remove horn contact, remove two retaining screws from actuator bar cap. Remove four clutch-head retaining screws from actuator bar. Remove four plastic retaining rivets from actuator plate. See Figure 10-55.

2. To remove horn connector brush, remove actuator bar cap. Remove actuator bar. Lift ground plate and horn connector brush from steering wheel. If steering

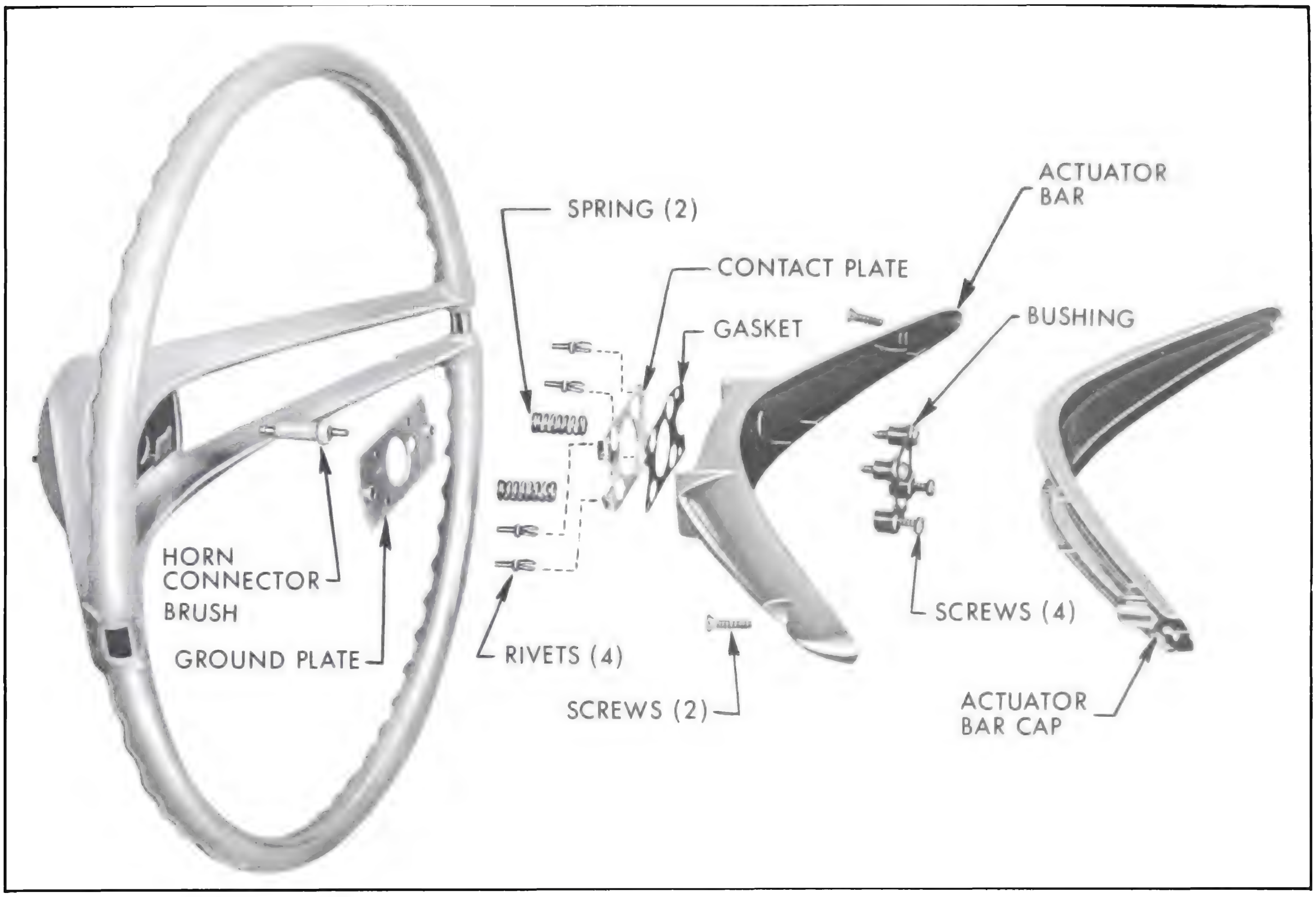


Figure 10-55—Horn Contacts

wheel must be removed, see Figure 10-56.

3. If horns still do not blow when wire at mast jacket is grounded, unplug double connector from horn relay part of junction block assembly. Then plug a known good relay and junction block assembly onto the connector and press battery terminal of new assembly against old junction block battery terminal stud for a source of current. Ground base of new relay. Have helper try blowing horns. If horns blow, original relay is defective and must be replaced.

4. If horns still will not blow with substitute horn relay trouble is elsewhere. Check wiring connections and wiring throughout horn circuit. See Figure 10-166 for wiring diagram.

b. Horns Will Not Stop Blowing

1. Pull horn wire from connector on wire that enters mast jacket (tan wire). If horns stop blowing, relay is OK, but horn control circuit in jacket is grounded. If horns do not stop blowing horn relay control circuit is grounded. Check horn wire and contacts in mast jacket and steering wheel if horns stopped blowing.

2. If horns still do not stop blowing, unplug double connector from horn relay. Then plug a known good relay onto the connector and make contact with junction block stud.

3. If horns now stop blowing, original relay contacts are sticking and relay and junction block assembly must be replaced. However, if horns still do not stop blowing, control circuit is grounded between relay and connector on wire that enters jacket.

c. Horn Tone is Poor

If either horn blows only part of the time or tone is poor, adjust current draw at horn, subparagraph e.

d. Voltage Test at Horn

An improperly operating horn and its wiring circuit can be tested by connecting a voltmeter between the horn terminal and ground and noting the voltage while the horn

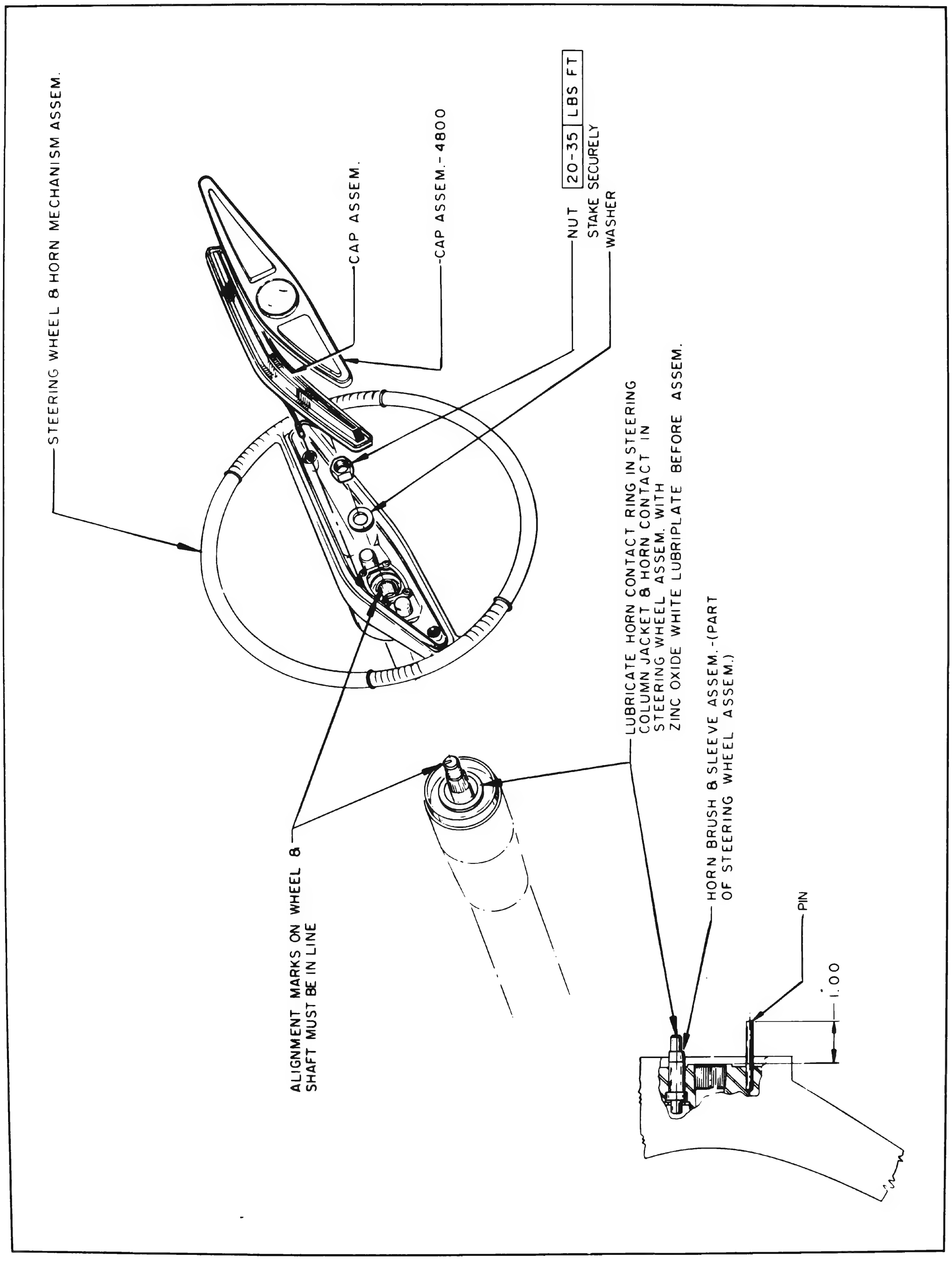


Figure 10-56—Steering Wheel Installation

button is pressed. The voltage at the horn gives an indication of the cause of trouble as follows:

1. No voltage indicates trouble in horn button, relay, wiring, or ground.

2. Less than 7 volts indicates trouble in wiring or excessive current draw due to short circuit in horn.

3. Voltage between 7 and 11 indicates that wiring is okay. Look for sticking or improper adjustment of horn.

4. Voltage above 11 indicates improper adjustment or open circuit in horn due to broken coil lead.

e. Adjustment of Horns

1. Remove horn from car.

2. Connect an ammeter in series with horn and a fully charged 12 volt battery to measure current draw while horn is blowing. Current draw for each horn either high or low note) should be between 4.5 and 5.5 amperes at 12.0 volts.

3. Adjust to specified current draw if necessary, by turning adjusting screw clockwise to decrease or counterclockwise to increase current draw. Turn only 1/4 of a turn at a time. If adjustment loosens screw excessively, it may be staked with a prick punch. See Figure 10-57.

Increasing the current draw increases the horn volume. Too much current will cause a high cut-in voltage which will cause a sputtering sound and may cause horn to stick in cold weather.

4. After each horn has been adjusted individually, sound both horns together to check for proper blend of tone. If adjustment does not provide a satisfactory tone, horn contacts are pitted,

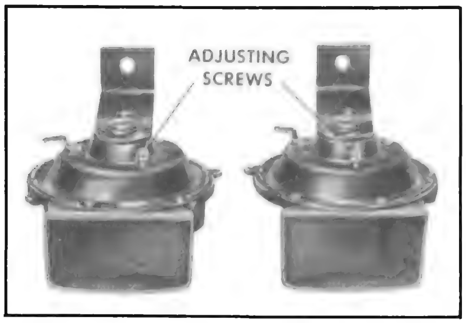


Figure 10-57—Matched Horn Set

making horn replacement necessary.

5. With horns reinstalled on car, connect a volt-meter between each horn terminal and ground to check voltage while both horns are blowing. This should be between 7 and 11 volts.

10-47 DIRECTION SIGNAL LAMPS AND SWITCH

a. Direction Signal Lamps and Indicators

The front direction signal light is produced by the 32 CP filament in the dual purpose bulb mounted in the front parking lamp. The rear direction signal light is produced by the 32 CP filament in the bulb of the rear lamp assembly. This filament also serves as a stoplight.

When the ignition switch is turned on and the direction signal switch is manually operated to indicate a turn, the front and rear signal lights flash on and off on the side of car for which a turn is indicated. The flashing of signal lights is caused by a flasher which is connected into the proper signal circuit by contacts made in the direction switch when switch is set for a turn.

When the direction signal lights are flashing, a signal indicator bulb on instrument panel also flashes, producing a green light to indicate the direction for which the signal has been set.

b. Direction Signal Switch Operation

The direction signal switch is mounted on the steering mast jacket under the instrument panel. Its actuating mechanism is enclosed in a housing on the jacket just below the steering wheel. Movement of the actuating mechanism is transmitted to the signal switch through an actuating rod which runs down the inside of the jacket.

The upper end of the actuating rod is crank shaped and fits in a slot in the lever plate. See Figure 10.58. The lower end of rod is attached to the signal switch by a spring pin which is installed around switch operating pin and through hole in rod. An anti rattle spring located on rod between spring pin and the positioning tab which is part of mast jacket, hold the rod in place. See Figure 10-59.

The turn signal control lever is threaded into the lever plate. When the lever is moved up or down, it causes the lever plate to rotate around a pivot screw and in turn the actuating rod is rotated. A detent spring mounted in the housing bears against a nylon

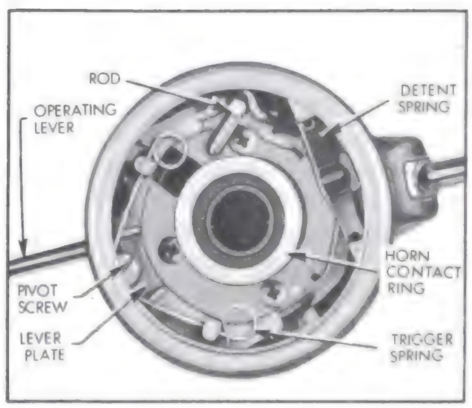


Figure 10-58—Top View of Direction Signal Switch Actuator

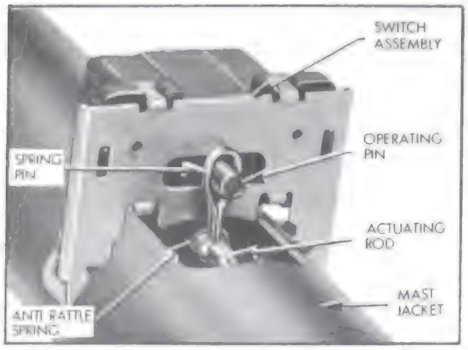


Figure 10-59—Direction Signal Switch Installation-Bottom View

roller mounted on the lever plate to hold the plate in whatever position it is set. Bosses in the housing provide stops for the plate when set for either turn.

The movement of the rod and switch actuator are not adjustable, therefore, any adjustment must be made by moving the switch on the steering mast jacket. See subparagraph d for the adjustment procedure.

The trip or cancellation mechanism for returning the switch to the "off" position after a turn is completed consists of a trigger spring on the lever plate and a switch cancelling pin on the steering wheel hub. The pin extends down through the lever plate, but when the switch is in the "off" position the lever plate is centered so that the pin cannot contact the trigger spring as the steering wheel is turned.

When the control lever is moved clockwise to set the switch for a right turn the lever plate is moved down bringing the upper loop of the trigger spring into the path of the cancelling pin. As the steering wheel is turned right and the cancelling pin contacts the trigger spring the spring yields to permit the pin to pass without interference. As the wheel is turned left at completion of the right turn, the cancelling pin pushes the loop of trigger spring against a stop on the lever plate, and this forces the lever plate and switch back to the "off" position.

A similar action but in the opposite direction takes place when the switch is set for a left turn. If the switch is erroneously set to indicate a turn in one direction and the turn is made in the opposite direction, the cancelling pin will contact the trigger spring and return the switch to the "off" position as the wrong turn is started.

c. Trouble-Shooting Direction Signal System

When a front of rear signal bulb is burned-out, the indicator light for that direction will stay on. This immediately notifies driver when any signal light quits operating.

1. No Signal Anywhere. If there is no signal at any front, rear, or indicator light, first check fuse on fuse block marked "DIR. SIG." Since this fuse also protects the stop light system, functioning stop lights indicate that fuse is OK.

If fuse checks OK, next eliminate flasher unit by substituting a known good flasher. If new flasher does not cure trouble, check signal system wiring connections at fuse block and at signal switch.

Also check to see if the spring pin that retains actuating rod to switch pin is properly installed or broken. See Figure 10-59.

2. Signals One Direction Only. If signal works properly on one side, but there is no signal at front, rear, or indicator light on other side, adjust direction signal switch. See subparagraph d below. If trouble cannot be corrected by adjustment, replace switch.

3. Signal Stays On One Direction. If the indicator light stays on in one direction (does not flash), check for a burned-out light bulb or an open circuit in wire to bulb not lighting.

NOTE: If brake stop lights function properly rear signal light bulbs are OK.

4. Fails to Cancel After Completion of Turn. If signal lights do not turn off after completion of turn, check for worn or broken switch actuator parts or for broken cancelling pin on steering wheel hub.

NOTE: It is necessary to removing steering wheel to service switch actuator parts.

d. Direction Signal Switch Adjustment

Whenever a directional signal switch is installed, it must be properly adjusted. Incorrect adjustment of the switch is indicated if the direction signal system operates in one direction only.

The directional signal switch is mounted on the mast jacket under the instrument panel. It is actuated by a rod from the actuator assembly on the upper end of the mast jacket. The movement of the rod is not adjustable, therefore any adjustment necessary must be made by moving the switch on the jacket.

Adjust direction signal switch as follows:

1. Place direction signal control lever in center position. (Switch actuator has center detent.)

2. Loosen two switch mounting screws and move switch sideways on mast jacket until operating pin projecting from switch is centered. See Figure 10-59. Tighten switch mounting screws.

3. To recheck adjustment, turn on ignition switch, place turn signal control lever in each position, and check all signal lights.

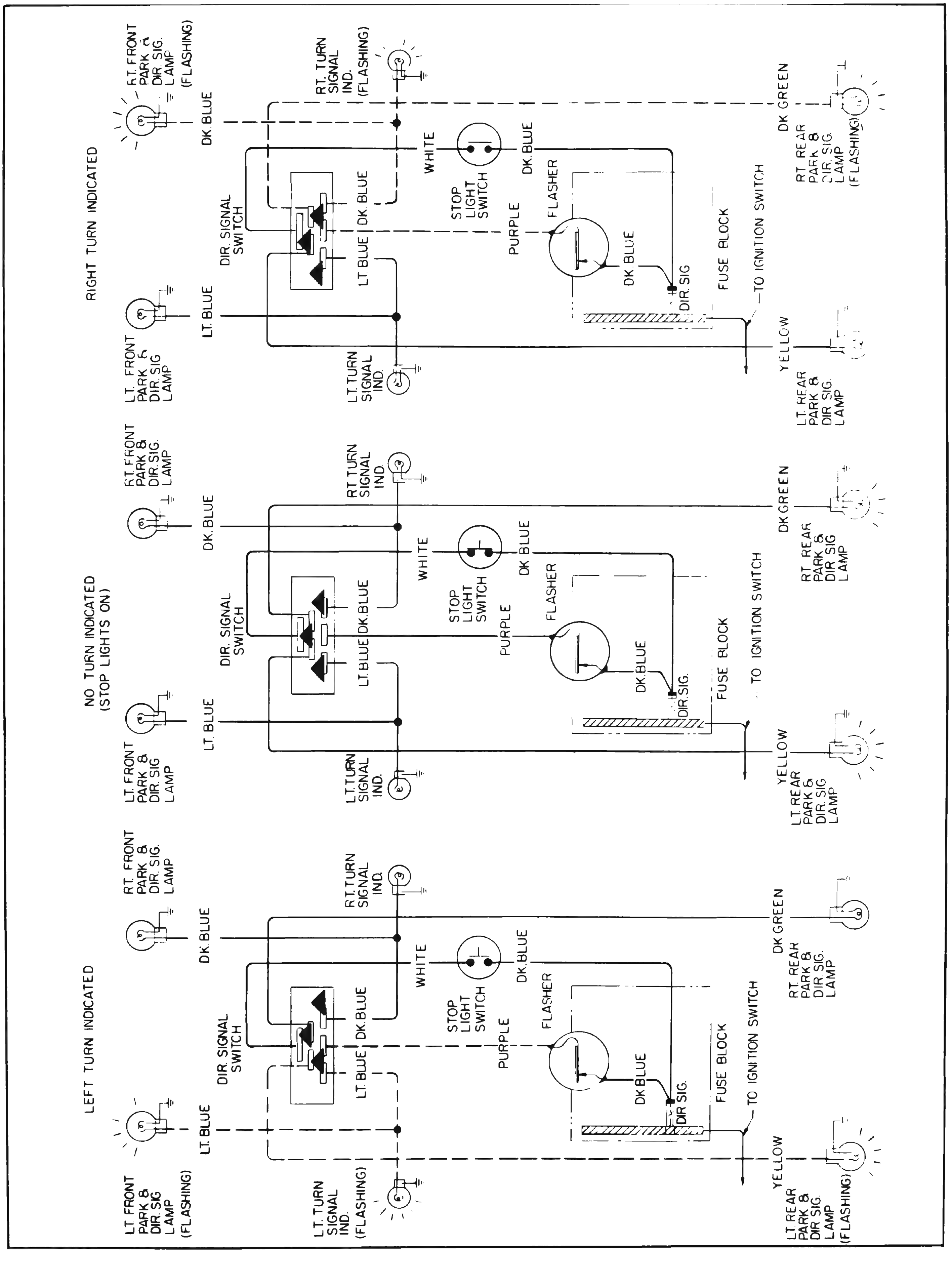


Figure 10-60—Turn Signal Wiring Diagram

e. Direction Signal Lamp Circuits

Since the direction signal lights are independent of the headlamp lighting switch and thermo circuit breaker, the wiring circuits are protected by a "DIR. SIG." fuse on the fuse block under the cowl. The flasher is also mounted on the fuse block, which serves as a terminal block between the signal switch and the chassis wiring.

Figure 10-60 shows the directional signal circuits when signal switch is set for No Turn, Right Turn, and Left Turn. Direction signal switch wiring is also shown in the wiring circuit diagram, Figure 10-145.

f. Removal of Direction Signal Actuator

1. Remove steering wheel. (Par. 8-5).

2. Unplug horn wire from connector located near where wire enters hole in mast jacket. Attach a long length of wire to horn wire terminal. Then remove spring, spring seat and horn contact and bearing assembly from actuator. See Figure 10-67. Disconnect length of wire from horn wire terminal. This wire will be used to feed horn contact wire back through mast jacket.

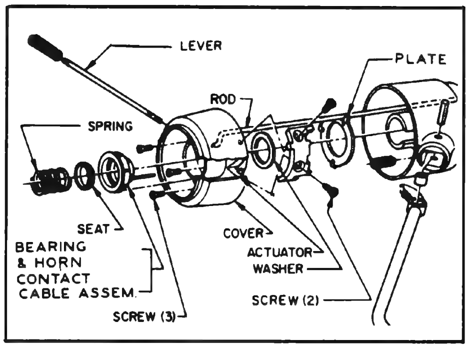


Figure 10-61—Direction Switch Actuator

3. Remove direction signal operating lever.

4. Remove direction switch. Remove spring pin and spring from lower end of actuator rod and pull rod out of actuator. See Figures 10-58 and 10-59.

5. Remove the three Phillip head screws that retain actuator to plate and lift actuator off of mast jacket. Remove cover from actuator.

6. To install actuator, reverse removal procedure paying attention to the following:

(a) If spring pin was bent during removal it may be difficult to properly install in actuator rod.

(b) Adjust direction signal switch.

(c) Apply Lubriplate to horn contact before installing steering wheel.

(d) Check operation of horn and direction signal system after installation is completed.

g. Cornering Lights

Cornering lights (optional equipment) provide extra light in the direction the car is turning. They operate from a special combined turn signal and cornering lamp switch. When either the parking lights or the headlights are on, moving the turn signal lever to indicate a turn causes a cornering light to come on in the direction of the turn. This light does not blink, but remains on steadily until the turn is completed. Each cornering lamp contains a 50 CP bulb. The cornering light circuit is protected along with the tail light circuit by the 10 ampere "TAIL LTS." fuse on the fuse block. See Figure 10-63.

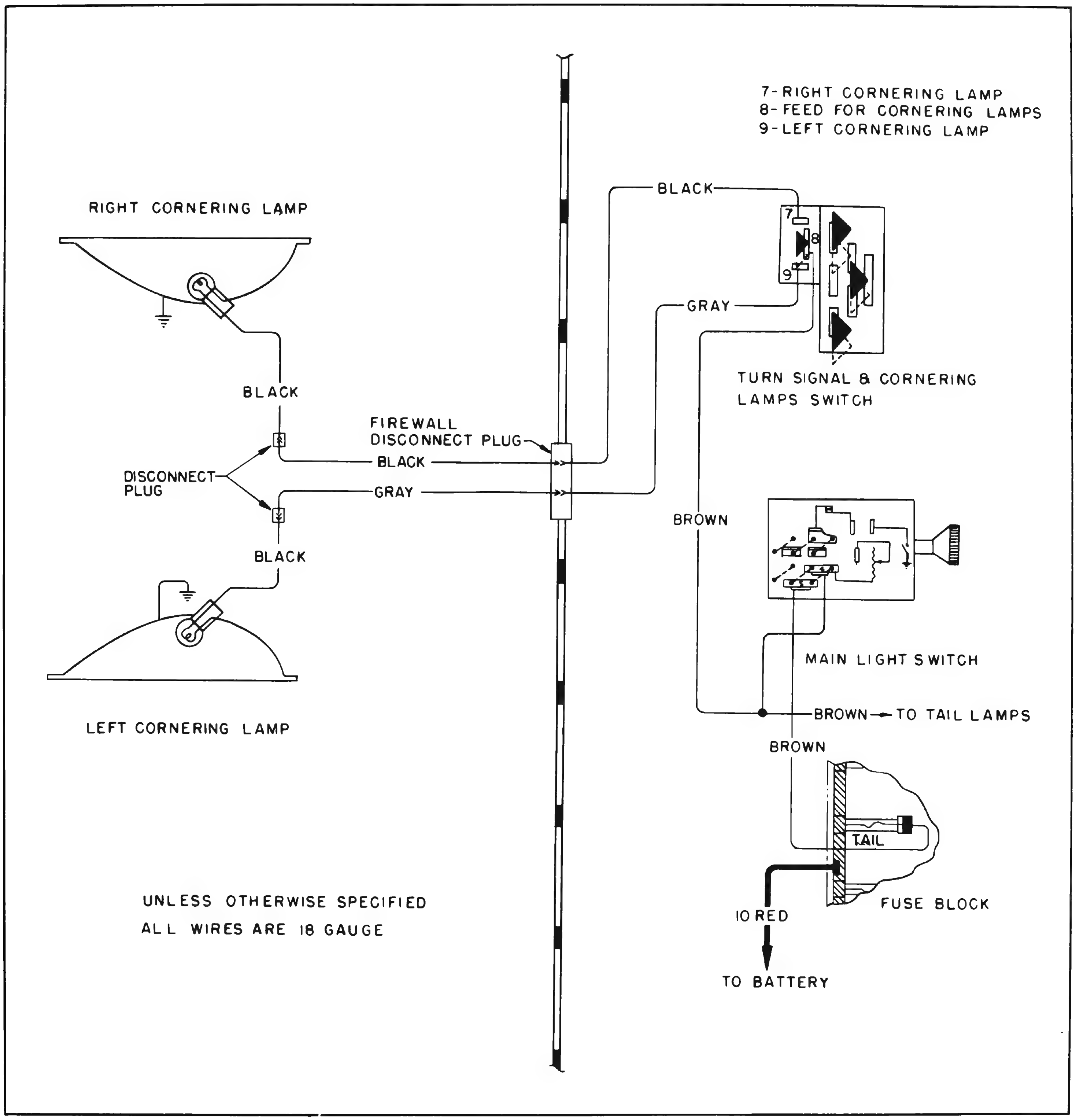


Figure 10-62—Cornering Lamp Wiring Diagram

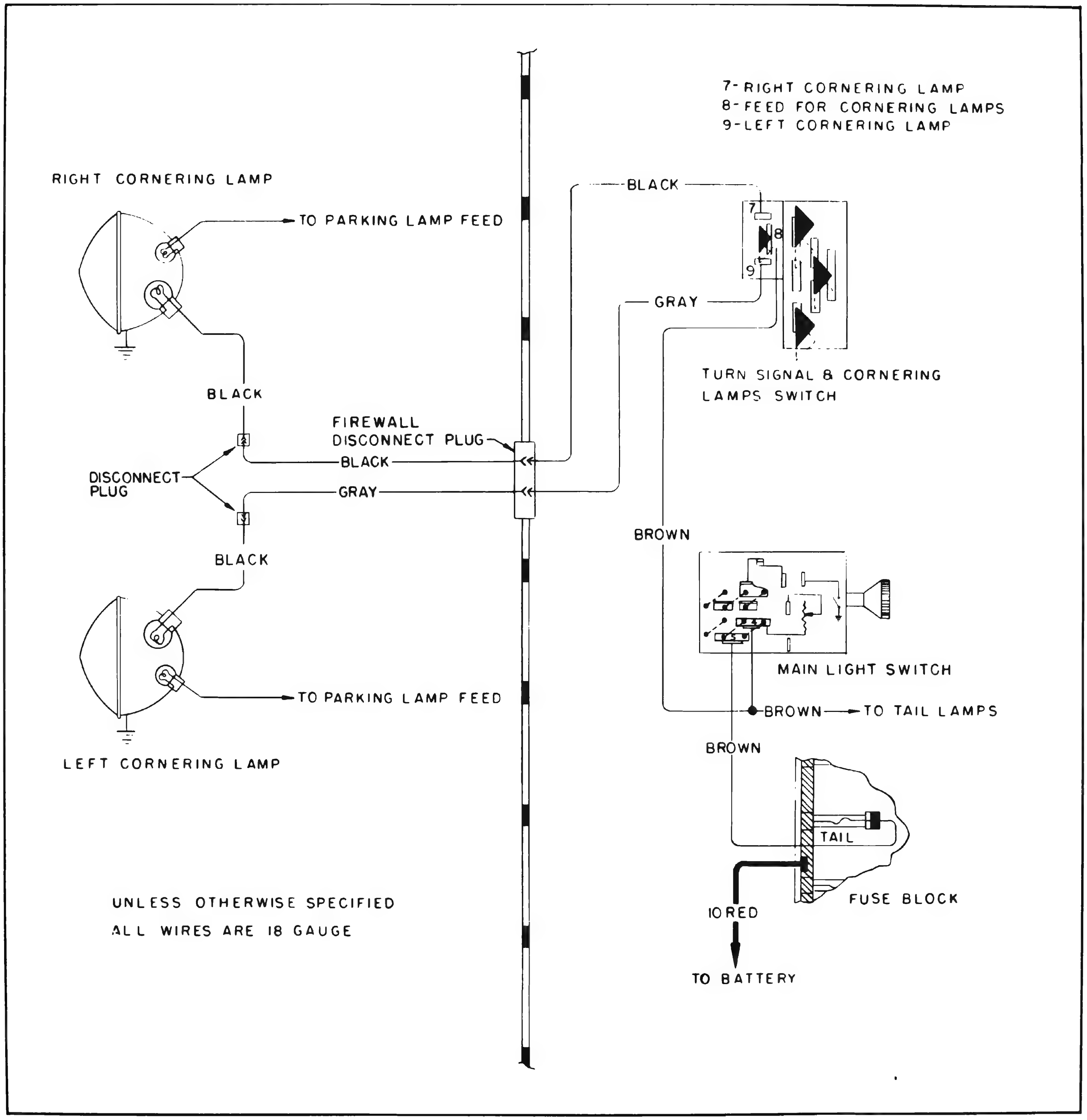


Figure 10-63—Cornering Lamp Wiring Diagram-Riviera

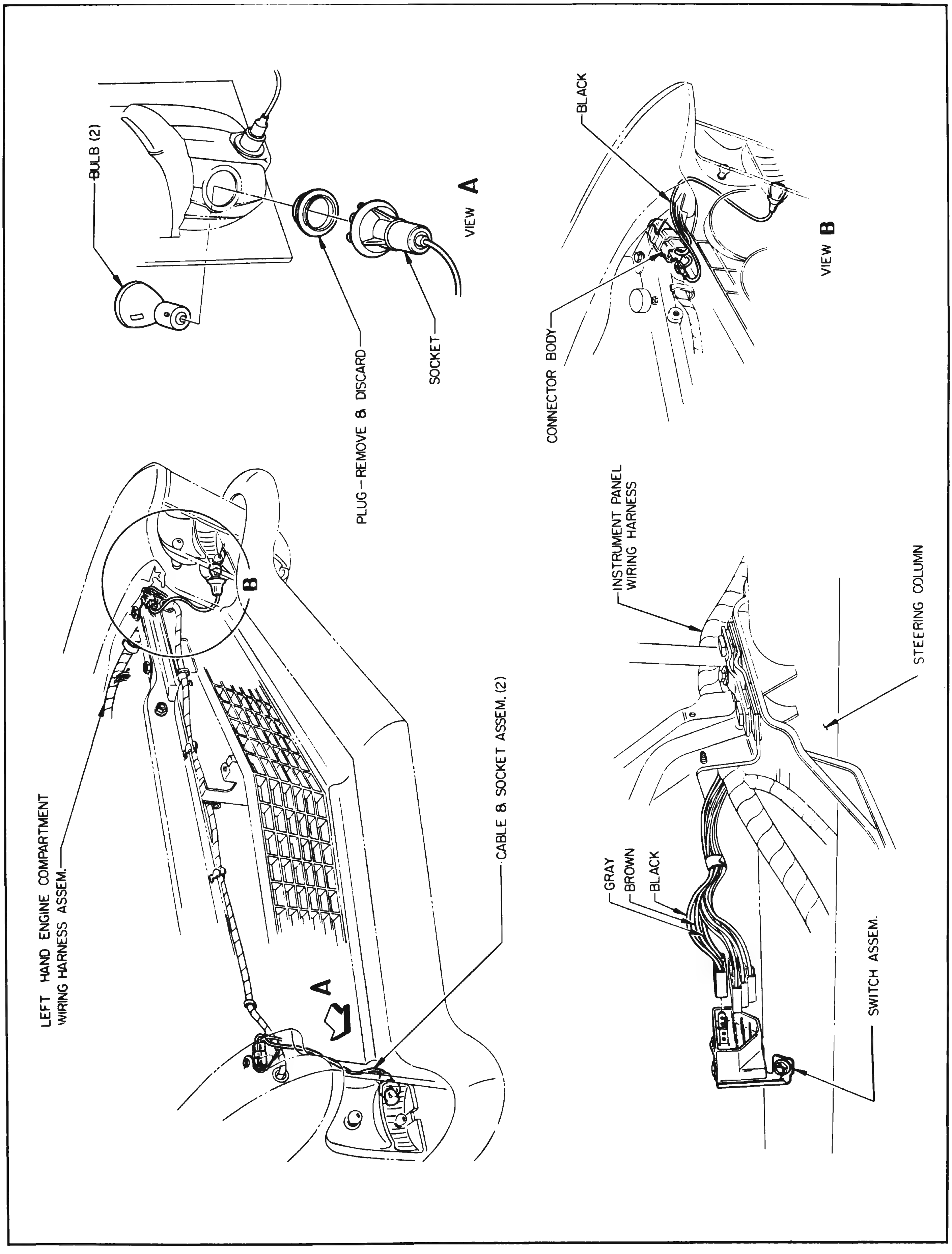


Figure 10-64—Cornering Lamp Wiring Installation-Riviera

SECTION 10-H

INSTRUMENTS AND CLOCK

CONTENTS OF SECTION 10-H

10-48 INSTRUMENT CLUSTER ASSEMBLY, GENERATOR, OIL PRESSURE, AND TEMPERATURE, INDICATORS

CAUTION: Disconnect battery ground strap before removing any instrument panel unit or wiring.

a. Description of Instrument Cluster Assembly

The instrument cluster assembly shown in Figure 10-65 or 67 contains the speedometer, fuel gauge, indicator lights and clock. For the instrument cluster location in the instrument panel, see Figure 10-66 or 68.

A printed circuit is used to complete the circuits for all the lights and instruments in the cluster assembly. See Figure 10-69. A disconnect plug which is part of the instrument panel wiring harness attaches to the printed circuit connector pins. A key way is located in the printed circuit to insure correct assembly of the disconnect plug on the connector pins. If the printed circuit should become defective, it should be replaced as it is not practical to repair it.

b. Removal and Installation of Instrument Cluster Assembly

The complete instrument cluster seldom needs to be removed unless the printed circuit is defective. The speedometer, clock or gas gauge can each be removed without disturbing the instrument cluster housing. However, when the cluster assembly must be removed, proceed as follows:

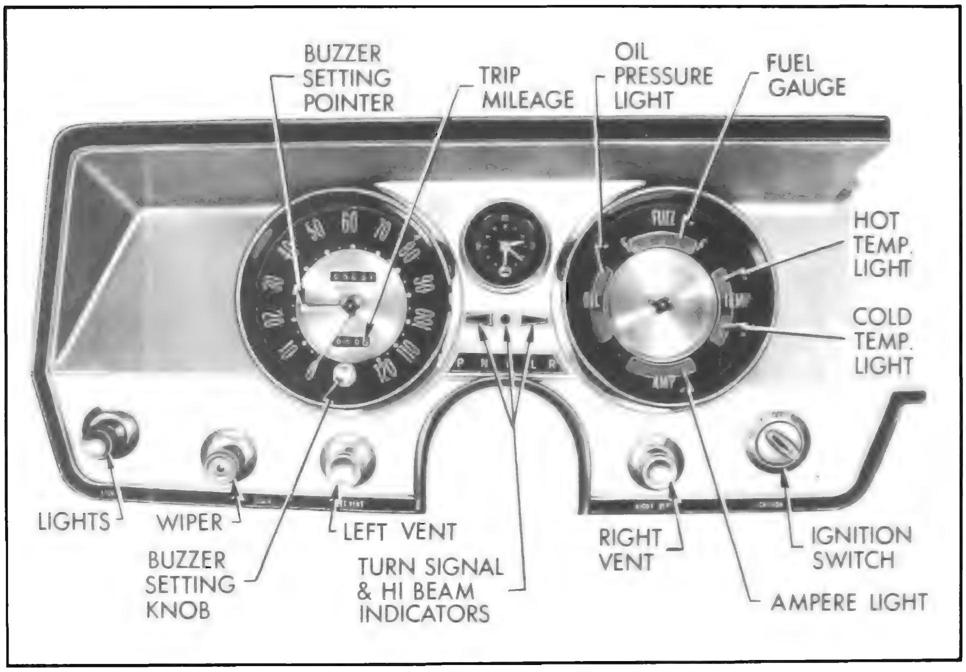


Figure 10-65—Instrument Cluster

1. Remove control panel and trim plate from center of instrument panel (since these overlap the right edge of the cluster housing).

2. Remove right and left lower access doors.

3. Disconnect wiring from light switch, wiper switch, ignition switch, ignition switch light, clock, clock light, multiple cluster connector and parking brake warning light. See Figures 141 thru 143.

4. Disconnect speedometer cable, left and right vent control cables, buzzer wire or cruise control wiring (if so equipped). Disconnect speedometer reset knob.

5. Remove upper left moulding by unsnapping from cluster. Remove exposed screws. See Figure 10-79.

6. Remove nuts from studs along lower edge of cluster. (Remove screws from Riviera cluster lower edge. See Figure 10-91).

7. Remove two nuts from steering column support and lower complete steering column.

8. Remove instrument cluster assembly.

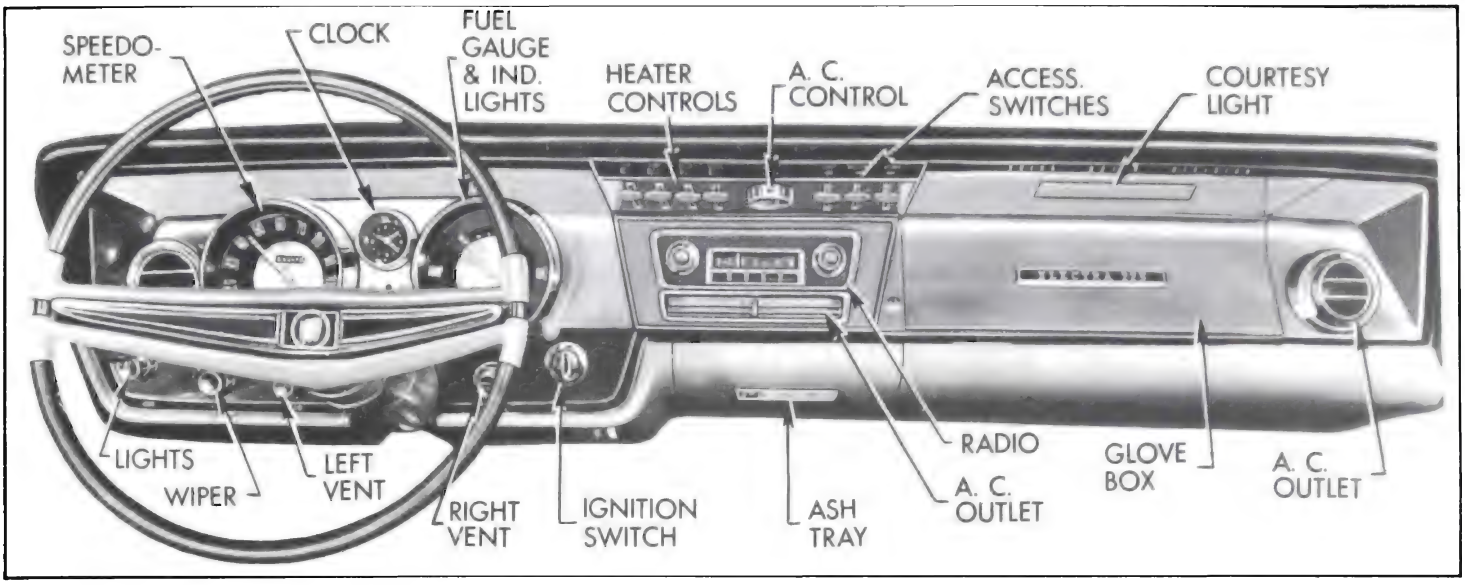


Figure 10-66—Instrument Panel

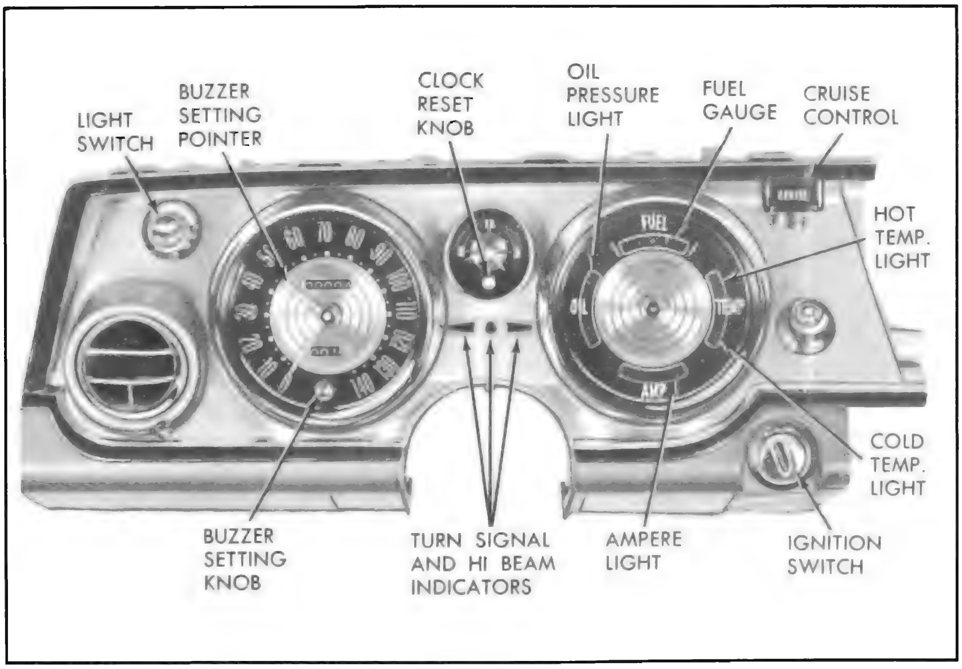


Figure 10-67—Instrument Cluster-Riviera

9. Install by reversing above steps.

c. Generator Charge Indicator

The red "GEN" warning light should light when the ignition is turned "ON" and before the engine is started; if not lighted, either the bulb is burned out or the indicator light wiring has an open circuit. After the engine is started, the "GEN" light should be out at all times; if the light comes on, the generator belt may be loose or missing, the generator or regulator may be defective, or the charging circuit may be defective. See paragraph 10-18 for trouble-shooting procedures.

To trace the generator indicator light circuit, see Figure 10-70 or 71. With the ignition switch turned on (engine not running), current flow is through the ignition switch, out the "IGN" terminal, through the generator light in the instrument cluster, to the "4" terminal of the regulator, through the lower contacts of the voltage regulator (held closed by the spring), out the "F" terminal of the generator, through the brush and slip ring, through the field, through another brush and slip ring to ground.

Before the engine is started, the generator light should glow at about 1/2 brightness. This is because the voltage in the circuit before the light is about 12 volts, but the voltage at the "4" terminal after the light is about 5 volts. This makes the effective voltage across the generator light approximately 7 volts for about 1/2 brightness.

After the engine is started, the voltage put-out by the generator immediately closes the field relay. This causes battery voltage from the "3" terminal to be present at the "4" terminal. See Figure 10-70 or 71. Since battery voltage is present on both sides of the generator light, the light goes out. If the generator light comes with the engine running, the charging circuit should be tested at the first opportunity to determine the cause of the trouble. See paragraph 10-21.

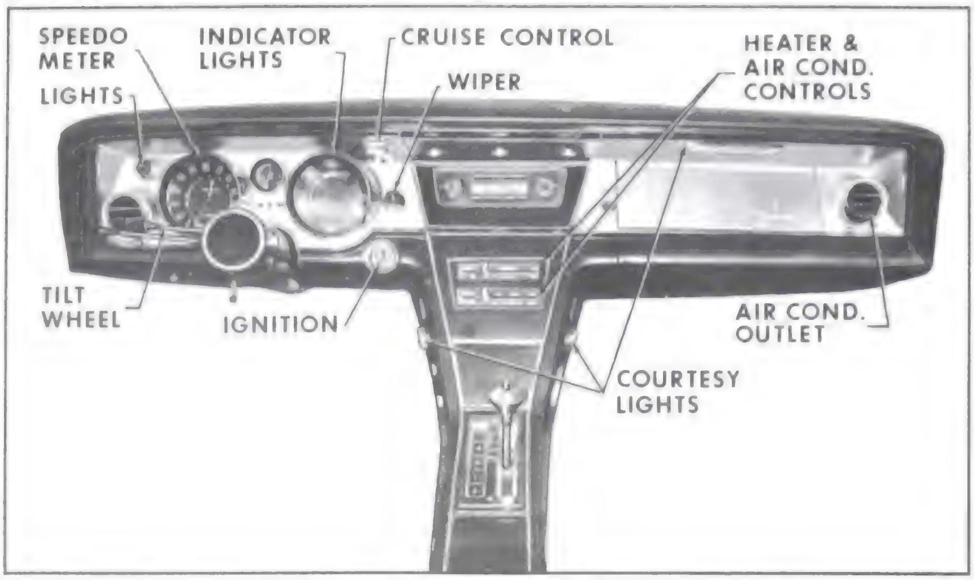


Figure 10-68—Instrument Panel-Riviera

d. Oil Pressure Indicator

The engine oil pressure indicator light is controlled by a pressure operated switch located in the main oil gallery at the right rear of the engine. See Figure 10-148 or 150.

This light should come on when the ignition is turned "on" and the engine is not running. If not lit, either the bulb is burned out, the wiring has an open or the oil switch is defective.

If the engine oil pressure drops below a safe level during operation, the circuit is completed through the pressure switch to ground, and the "Oil" indicator light in the cluster will be turned on.

If the "Oil" indicator stays on or comes on when the engine is running at speeds above idle, the following may be the cause, rather than low oil pressure:

1. Wiring circuit between oil pressure switch and light grounded. Remove connector from pressure switch, if light stays on trouble is in wiring.

2. Switch defective. Replace switch.

e. Temperature Indicator

A temperature switch located in right cylinder head controls the operation of a "Cold" temperature indicator with a green lens and a "Hot" temperature indicator with a red lens. See Figure 10-148 or 150.

When the cooling system water temperature is below approximately 110 degrees F., the temperature switch grounds the "Cold" indicator circuit and the "Cold" on the instrument cluster is lit. When the "Cold" light goes out, the water temperature is high enough so that the heater can be turned on and be effective. The car should never be subjected to full throttle accelerations or high speeds until after the "Cold" light has gone out.

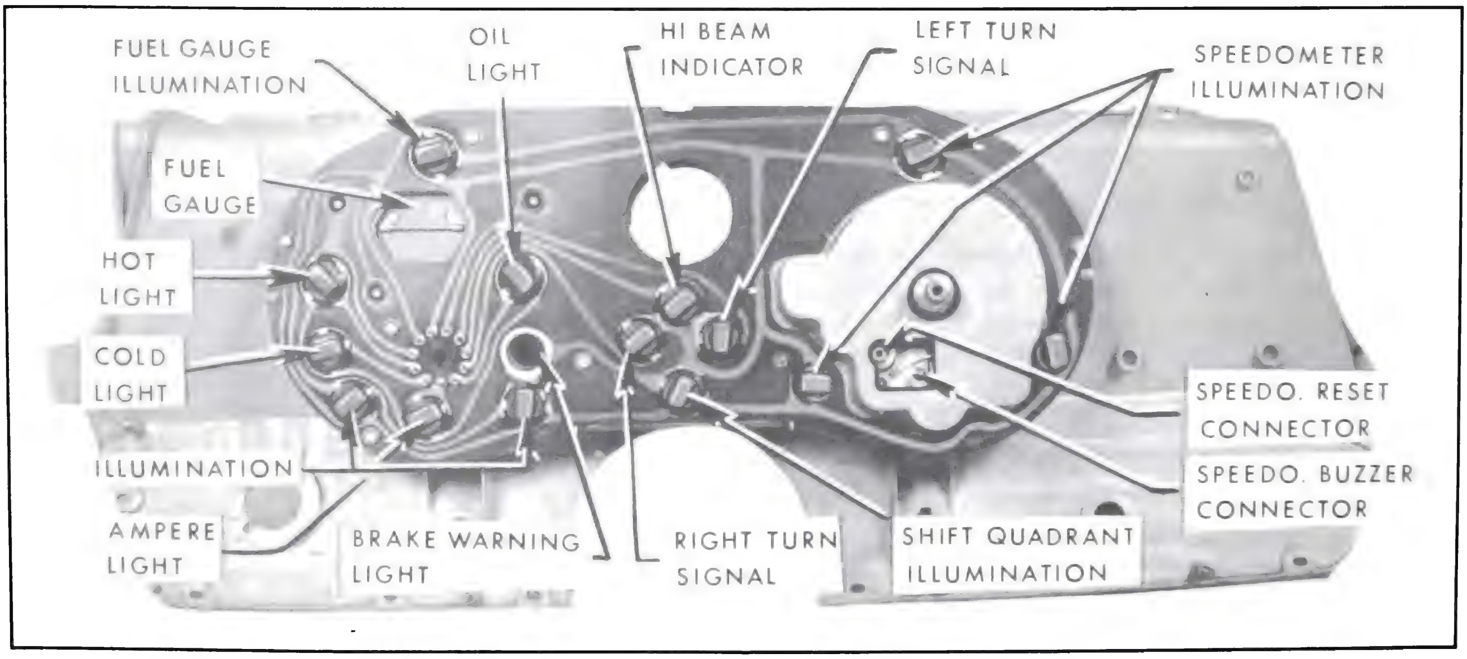


Figure 10-69—Instrument Cluster-Back Side

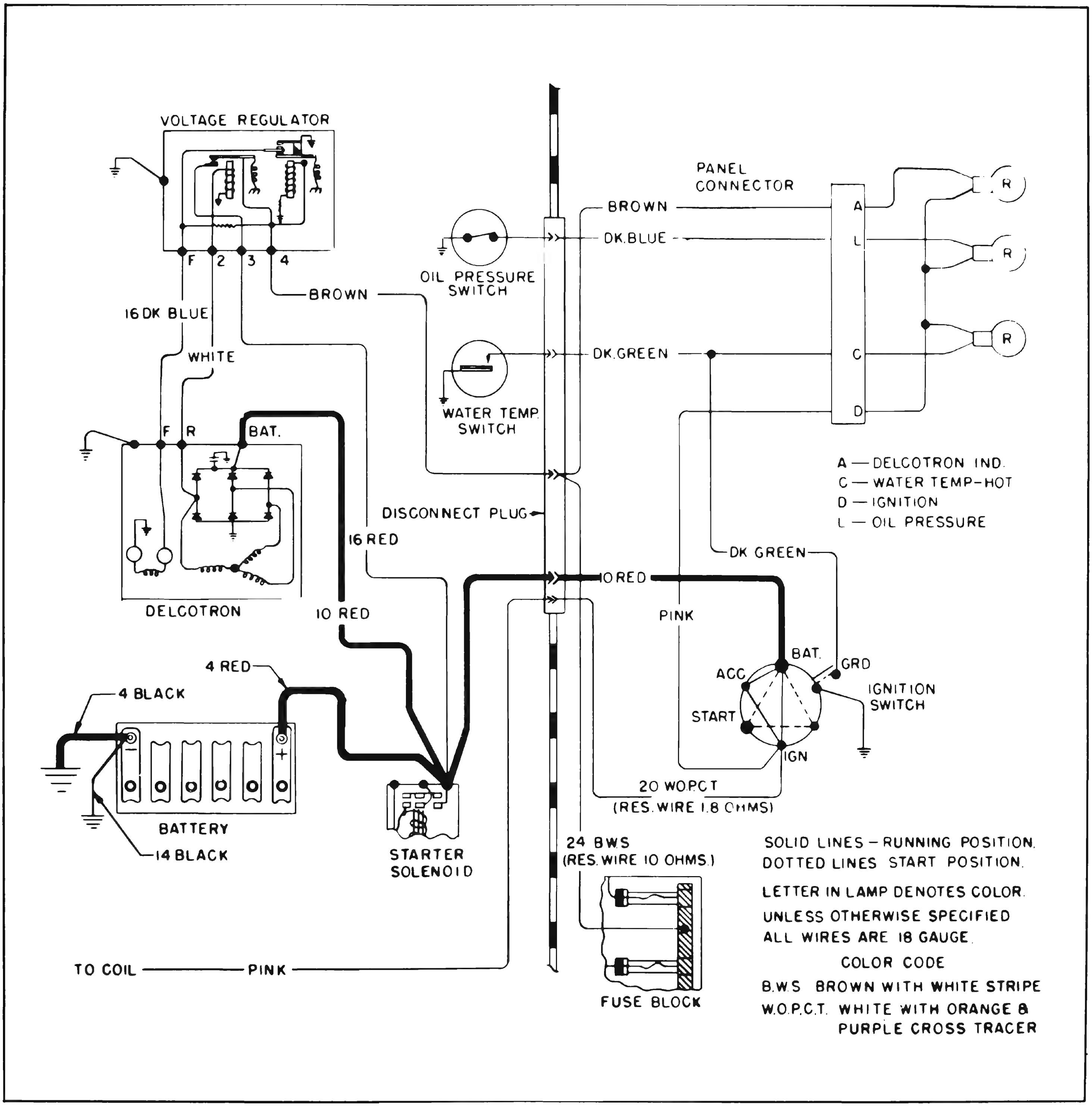


Figure 10-70—Indicator Warning Light Circuits - Series 4400

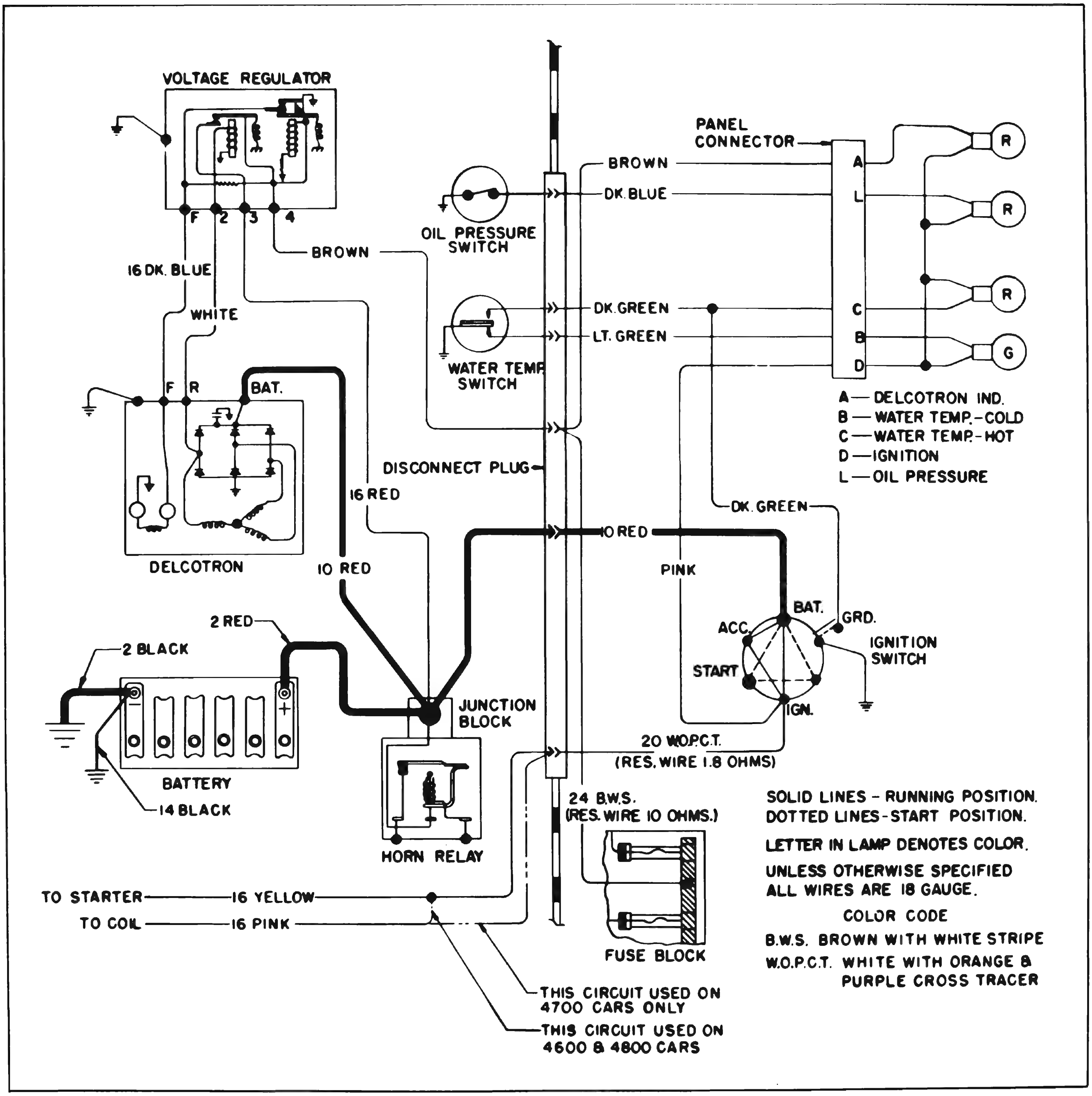


Figure 10-71—Indicator Warning Light Circuits - Series 46-47-4800

COMPLAINT	POSSIBLE CAUSE
1. GENERATOR INDICATOR (See Par. 10-18)	
Light on, ignition "Off".	Positive diode shorted. Locate and replace.
Light not lit, ignition "On" and engine not running.	Bulb burned out. Replace.
	Open in light circuit. Locate and correct.
	Positive diode shorted. Locate and replace.
Light on, engine running above idle speed.	No generator output. Check output, paragraph 10-21.
	Loose or broken generator belt.
	Resistance or open in field circuit.
	Defective field-light relay.
2. OIL PRESSURE INDICATOR	
Light not lit, ignition "On" and engine not running.	Bulb burned out. Replace.
	Open in light circuit. Locate and correct.
	Oil pressure switch defective. Replace.
Light on, engine running above idle speed.	Wiring between light and switch grounded. Locate and correct.
	Oil pressure switch defective. Replace.
	Oil pressure below 2 lbs. Locate cause and correct.
3. TEMPERATURE INDICATORS	
(a) Hot Indicator	
Light not lit when cranking engine.	Bulb burned out. Replace.
	Open in light circuit. Locate and correct.
	Ignition switch defective. Replace.
Light on, engine running.	Wiring between light and switch grounded. Locate and correct.
	Temperature switch defective. Replace.
	Cooling system water temperature above 248°F. Find cause and correct.
	Ignition switch defective. Replace.
(b) Cold Indicator	
Light not lit, ignition "On" and engine cold.	Bulb burned out. Replace.
	Open in light circuit. Locate and correct.
	Water temperature switch defective. Replace.
Light on, after normal engine warm-up period.	Wiring between light and switch grounded. Locate and correct.
	Water temperature switch defective. Replace.
	Thermostat in cooling system defective. Replace.

If the engine cooling system is not functioning properly and the water temperature should reach approximately 248 degrees F., the "Hot" indicator will be turned on by the temperature switch. As a test circuit to check whether the "Hot" indicator bulb is functioning properly, a wire which is connected to the "GND" terminal of the ignition switch is tapped in to its circuit. See Figure 10-70 or 71. When the ignition is in the "Start" position (engine cranking), the "GND" terminal is grounded inside the switch and the "Hot" indicator bulb will be lit. When the engine is started and the ignition switch is in the "On" position, the test circuit is opened and the bulb is then controlled by the temperature switch.

f. Trouble Diagnosis—Generator Indicator, Oil Indicator, Pressure Temperature Indicator

Use Figure 10-70 or 71 to trace wiring circuits for indicator lights and Figure 10-69 for location of indicator light bulb socket. To determine if there is a ground in the indicator light circuit, remove connector from control switch, if light stays on, trouble is in circuit.

10-49 ELECTRIC CLOCK

The electric clock is mounted in the center of the instrument cluster. The clock wiring circuit is

Figure 10-72—Electric Clock

protected by the "CLOCK" fuse on the fuse block. The clock light is controlled by the rheostat in the lighting switch and is protected by the "INST. LTS." fuse on the fuse block. If burned out, this bulb is accessible by removing one of the lower access doors.

a. Clock Time Reset and Automatic Regulation

The electric clock has a sweep-second hand and an automatic regulator. A reset knob extends through the glass at the bottom of the clock dial. To reset the time, pull the knob out and turn in either direction as required. See Figure 10-75.

There is no regulator knob because regulation is accomplished automatically by the action of resetting the time. If a clock is running fast, the action of turning the hands back to correct the time will automatically cause the clock to run slightly slower; if a clock is running slow, the action of turning the hands forward to correct the time will automatically cause the clock to run slightly faster (10 to 15 seconds per day).

A lock-out feature prevents the regulator mechanism from being moved more than once during a rewind period (approximately 3 minutes), regardless of the number of times the clock reset is operated. After clock rewinds, if it is again reset, automatic regulation will take place.

b. Clock Service

The clock manufacturers have established Authorized Service Stations in many cities throughout the United States and Canada. These service stations are prepared to carry out terms of the manufacturer's warranty and also to perform any repairs made necessary through use of clock.

When a clock requires warranty service or repairs other than regulation, it should be removed by the Buick dealer and sent to the nearest authorized service station. The manufacturer's warranty is void if repairs have been attempted outside of an authorized service station.

10-50 GASOLINE GAUGE SYSTEM—DESCRIPTION AND OPERATION

The gasoline gauge system consists of a dash unit (located in the instrument cluster), a tank unit (located in the gasoline tank), a wire between these two units, and a wire to supply battery voltage to the dash unit. See Figure 10-73. The single tank unit terminal is connected to one dash unit terminal with a tan wire. The other dash unit terminal is connected to the ignition switch with a pink wire so that voltage to energize the system is supplied only when the ignition switch is turned on. The dash unit has a balanced-type pointer; when the ignition is turned off, the pointer may come to rest any place on the dial.

The dash unit pointer is moved by changing the balance between the magnetic pull of two coils in the unit. This balance is controlled by action of the tank unit which contains a variable rheostat, the value of which varies with movement of a float and arm. The tank unit is mounted in the tank so that the float rises and falls on the surface of the gasoline. The float is adjusted to provide approximately 1 gallon reserve when the dash unit pointer is at the dot next to the "E" position.

When the ignition switch is "On" and the tank unit arm is in the full position (maximum resistance for the tan wire to ground), the current flow to ground is through the resistor, battery coil and the

ground coil. Due to the fact that the ground coil has more windings than the battery coil it builds up a stronger magnetic field and the dash unit pointer is pulled to the "F" position. See Figure 10-73. When the tank unit arm is in the empty position (no resistance for tan wire to ground), the current flow is through the resistor, the battery coil and the tan wire to ground at the tank unit. The dash unit pointer is thus pulled to the "E" position.

10-51 GASOLINE GAUGE—TROUBLE DIAGNOSIS

If the gasoline gauge does not operate properly, the dash unit, tank unit wiring and the tank unit should be separately tested to determine which is at fault. The units and wiring may be tested by using a known good tank unit with a 12 foot piece of red insulated (#16) wire attached to binding post of unit and a similar 5 foot piece of black wire attached to flange of unit. Attach a spring clip to end of black wire and a terminal to end of red wire.

1. Test of Wiring Between Dash Unit and Tank Unit.

(a) Disconnect the tank unit tan wire at frame side rail. This connector is located at top of right frame rail just forward of gas tank on all models except estate wagons. On estate wagons the connector is located at the left front corner of gas tank.

Plug the red test wire terminal into the connector and attach the black test wire to any convenient ground on the car.

(b) Turn ignition switch on and move arm of test unit up and down against the stops while observing dash unit. If dash unit and wiring are okay, dash unit pointer will move freely from "Empty" to "Full" with movement of tester arm, indicating that trouble is in tank unit or the short wire leading to it.

(c) If, on the test of dash unit and tank unit wiring, dash unit reads "Empty" or noticeably low at all times, look for a ground in the wiring circuit between dash unit and connector at frame rail. Also an improper grounded dash unit will cause unit to read low. If dash unit reads above "Full" or noticeably high at all times during test, look for points of high resistance or open circuit in wiring.

(d) To eliminate the tank unit brown wire which runs through body to connector at frame rail, remove the left kick pad and unplug wiring harness connector. Contact brown wire in connector with red wire of test unit, ground test unit and turn ignition switch on. If the dash unit functions properly with movement of test unit arm, trouble was caused by the brown wire.

2. Test of Dash Unit

(a) Disconnect wiring connector under left kick pad. Attach test unit red wire to connector tan wire leading to dash unit; attach test unit black wire to ground.

(b) Make sure multiple connector at instrument cluster is plugged in securely.

(c) Turn ignition on. Move arm of test unit up and down against stops. If dash unit pointer moves freely from "E" to "F" with movement of tester arm, dash unit is okay. If pointer does not move or only moves part way, printed circuit may be defective, dash unit may not be grounded properly, or dash unit may be faulty.

(d) Before removing complete

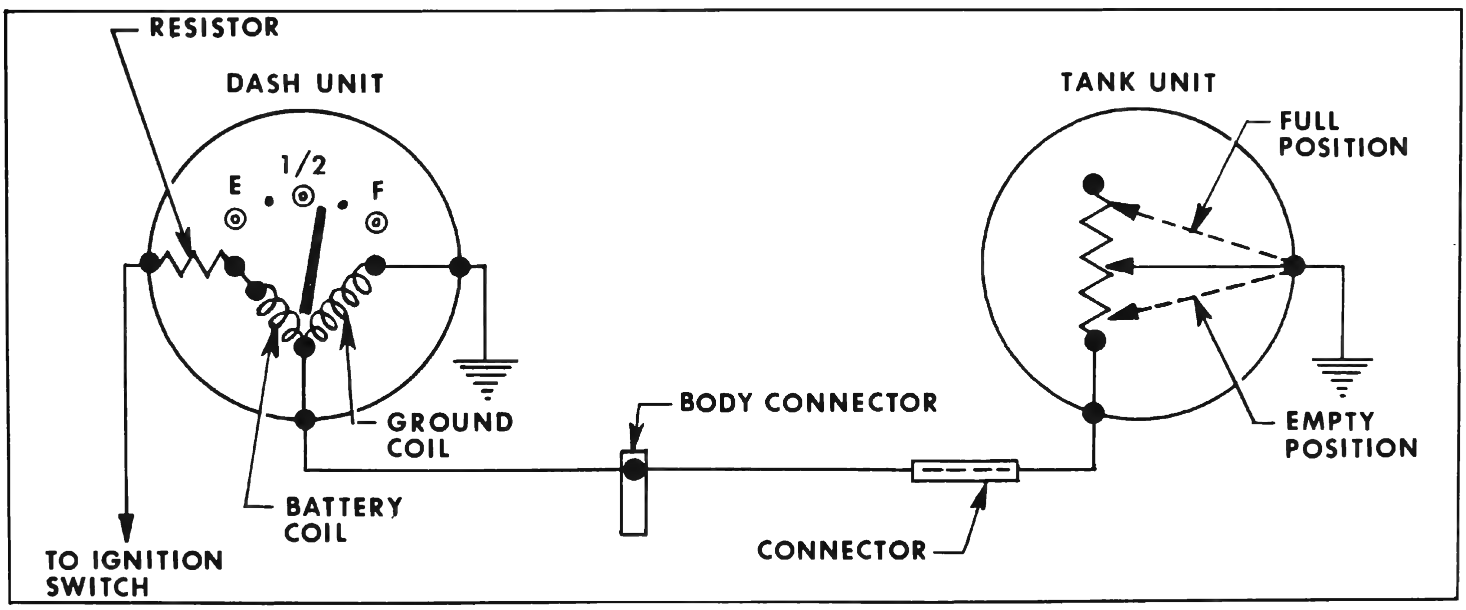


Figure 10-73—Gasoline Gauge Circuit

instrument cluster to check printed circuit, try replacing dash unit with a known good unit as follows:

(1) Remove Allen set screw from bezel and remove bezel.

(2) Remove dial face.

(3) Remove three screws from dash unit and remove unit.

(e) If pointer of new dash unit will not move properly with movement of tester arm, printed circuit is probably defective. Remove instrument cluster assembly as described in paragraph 10-48, b.

3. Test of Tank Unit.

(a) If tests given above indicate that the trouble is in the tank unit, check the tank unit wiring and if necessary, remove the unit so that it may be cleaned and tested. Tank unit is accessible through trunk compartment by removing cover from floor pan (except in wagons or Rivieras.)

(b) After thorough cleaning of tank unit, connect it to ground and to wire leading to dash unit, and test in the same manner as when using tester. If tank unit tests okay it should be reinstalled in tank, otherwise, it should be replaced with a new unit. When installing tank unit make certain that insulation is folded over the terminal and snapped over wire.

10-52 SPEEDOMETER

a. Speedometer Heads

The speedometer head has a magnetic speed indicator and a gear driven odometer. It is driven by a flexible cable connected to a worm gear in the transmission rear bearing retainer.

The speed indicating portion of the speedometer operates on the magnetic principle. There is a permanent magnet in the speedometer head which rotates at the same speed as the cable. This magnet exerts a pull on a speed cup causing it to move through an arc in direct ratio to the revolving magnet speed. A pointer is attached to the speed cup spindle to indicate speed on the speedometer dial. A calibrated hair spring (part of speed cup) opposes the magnetic pull on the speed cup so the pointer indicates speed accurately; this spring also rotates the cup and pointer to zero when the car stops.

Some speedometers have a trip odometer and a reset knob. Pushing the reset knob in and turning clockwise gives a quick reset to zero; turning the knob counterclockwise resets the trip odometer 1/10 mile at a time. Speedometers which have the trip odometer also have either the safety buzzer or the cruise control.

b. Checking Noisy Speedometer

1. Jack up rear wheels in a safe manner and close car windows to exclude outside noises.

2. With transmission in direct drive, run slowly from 0 to 50 MPH and back to 0, noting speed range where noise appears.

3. Apply brakes and shift transmission to park position, then run engine through same speed range as before.

4. If the noise continues even with the transmission output shaft stationary, something other than the speedometer installation is at fault.

5. If noise disappears with transmission stationary, check further for cause of noise by checking for proper installation of speedometer cable as shown in Figure 10-74 or 75..

6. If cable installation is okay, next remove inner cable from casing. Lay inner cable on clean paper to keep dirt from cable lubricant. Reconnect empty casing to speedometer and recheck for noise at various speeds. If noise still continues, noise is coming from transmission rather than from speedometer or cable.

7. If noise stops with inner cable removed, speedometer or cable is at fault. Inspect cable as described in subparagraph c.

c. Inspection of Speedometer Cable and Casing

If the speedometer installation appears to be noisy or the speed indicator wavers, inspect the cable casing for damage, sharp bends, or for being out-of-position in the supporting clips. See Figure 10-74 or 75. If casing is in good condition and properly installed, remove inner cable for inspection.

1. Disconnect cable casing at speedometer head, then pull inner cable out of upper end of casing.

2. Inspect cable for worn spots or breaks. Check cable for kinks by holding one end vertically in each hand and turning cable slowly; if cable is kinked, the loop will "flop". Replace a cable which has kinks or bent tips.

3. Before installing a new inner cable, work AC spec. 640 speedometer cable lubricant into the cable thoroughly, then wipe off all excess lubricant. Since the speedometer casing has a Delrin (plastic) liner, this lubricant is used as a rust preventive only.

4. If noise is still present, install a new speedometer cable assembly.

5. If this does not correct noise, have speedometer head checked by a UMS Service Station.

d. Trouble-Shooting Speedometer Safety-Buzzer

The safety-buzzer consists of a buzzer which may be adjusted by the driver to sound at any speed

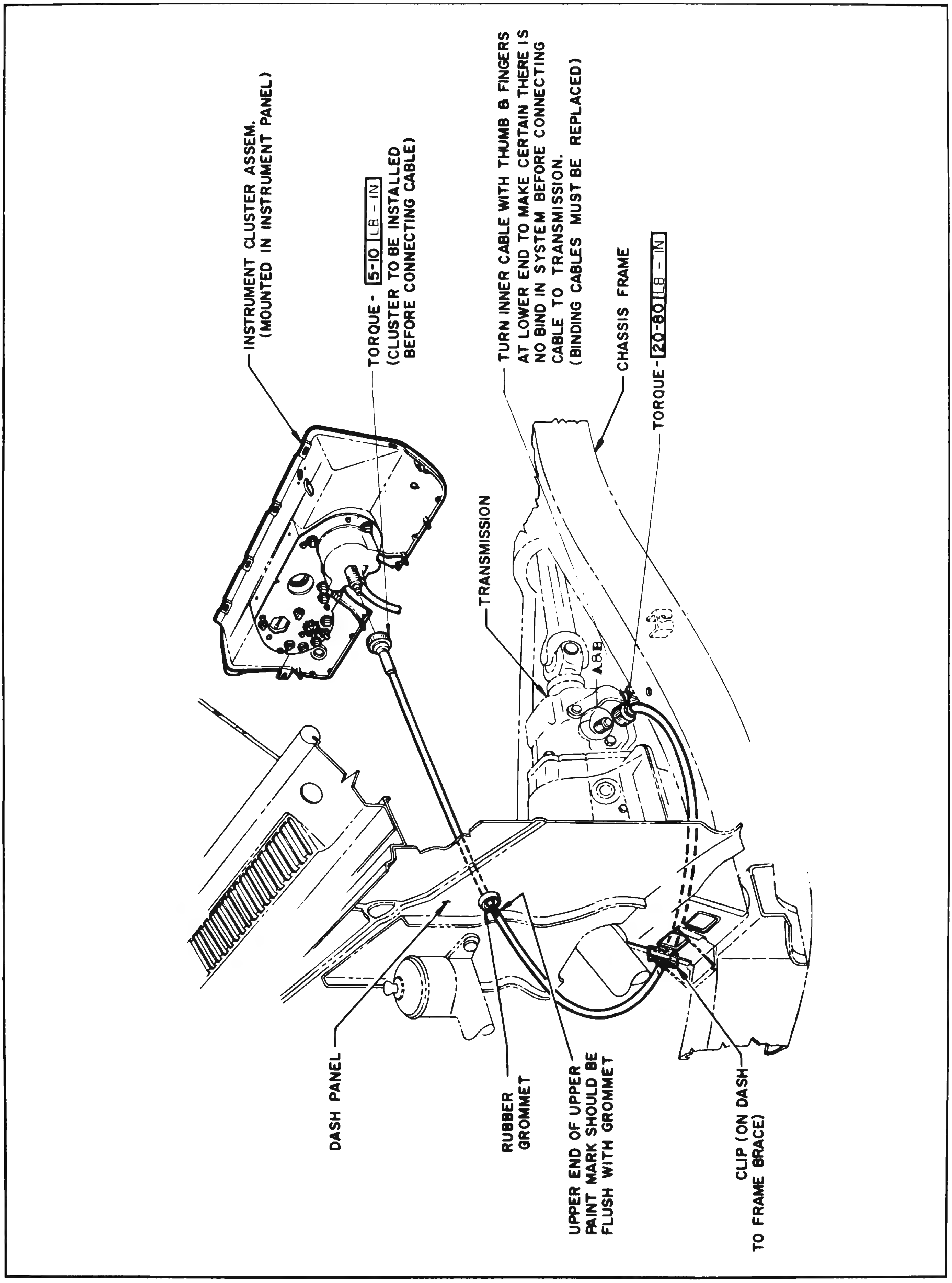


Figure 10-74—Speedometer Cable Installation

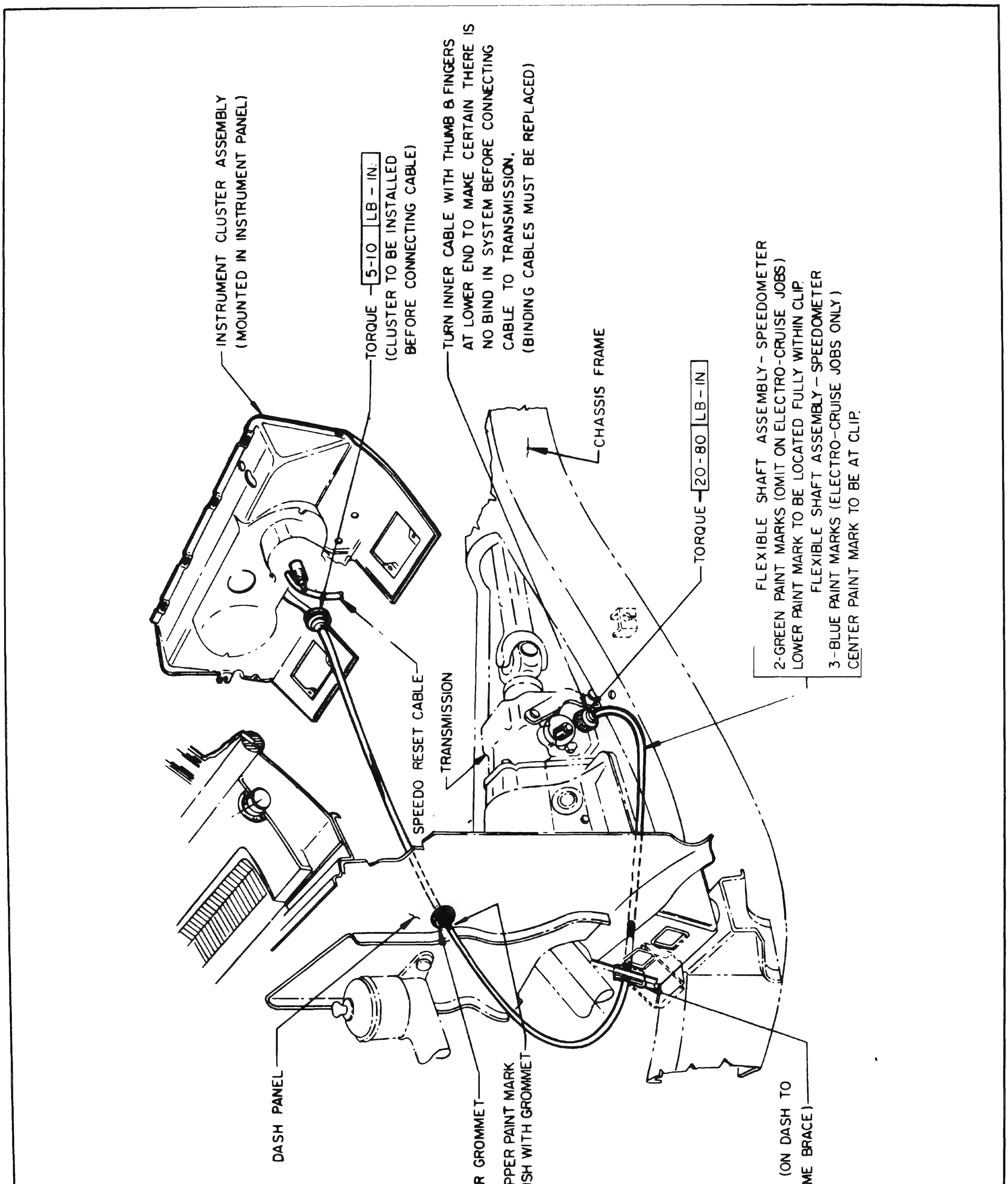


Figure 10-75—Speedometer Cable Installation—Riviera

between 30 and 90 MPH by turning a knob at the bottom of the speedometer face. See Figure 10-69. The speed at which the safety-buzzer is set is indicated by a special pointer with a yellow ball in the speedometer face. When the pointer is turned to the end of its travel (90 MPH), the buzzer turns off.

The safety-buzzer electrical circuit starts at a 6 ampere fuse marked "BK & BZ" located on the fuse block. Since this fuse also protects the parking brake warning light, a functioning warning light indicates that this fuse is OK. This circuit is "hot" whenever the ignition switch is turned on. From the fuse, a dark green wire carries the current to a buzzer mounted on a bracket located under right side of instrument cluster. See Figure 10-136. After passing through the buzzer contacts, a very small amount of current goes through a resistor to ground and the rest of the current passes through a blue wire to the connector plug located on the speedometer case.

In the speedometer, current is conducted from the separate buzzer connector through a wire to an insulated pin in the lower end of the safety-buzzer pointer. As the speedometer pointer moves up to coincide with the safety-buzzer pointer, a light grounding hair spring on the lower end of the speedometer pointer makes contact with the "hot" insulated pin on the safety-buzzer pointer. This grounds the circuit, causing the buzzer to buzz. If the car speed is increased beyond the safety-buzzer setting, the insulated pin on the safety-buzzer pointer "picks-up" the hair spring as the speedometer pointer passes under the safety-buzzer pointer and the light grounding hair spring winds-up slightly.

1- <u>Buzzer Will Not Operate Or Operates Intermittently.</u>

(a) Turn ignition switch on.

(b) To check buzzer, stick a prod in terminal at buzzer connector with the blue wire and run jumper to ground. If buzzer now operates, circuit is OK through buzzer and trouble must be in wire to speedometer or in speedometer. To check buzzer circuit up to speedometer, stick prod in buzzer connector at speedometer and run jumper to ground. See Figure 10-69. If buzzer operates, circuit is OK to speedometer so trouble must be in speedometer.

(c) If buzzer did <u>not</u> operate when buzzer connector was grounded (in Step b), trouble may be in buzzer circuit. Check "BK & BZ" fuse on fuse block and replace 6 ampere fuse if necessary.

NOTE: <u>Since this fuse also protects the parking brake warning light, a functioning warning light indicates that this fuse is OK.</u>

(d) Check buzzer circuit wiring connectors at fuse block and at buzzer.

(e) Next eliminate buzzer as source of trouble by unplugging connector at buzzer. Then plug a known good buzzer onto the connector and ground buzzer.

2. <u>Buzzer Operates Continuously</u>

(a) Check blue wire from buzzer to speedometer for ground.

(b) Remove buzzer connector at speedometer. If buzzer stops, circuit is grounded inside speedometer and speedometer must be removed for repair. If buzzer still operates, however, buzzer unit is defective and must be replaced.

3. <u>Speedometer Defective</u>

A defective speedometer assembly must be sent to the nearest UMS Service Station for repairs.

10-53 ACCESSORY SWITCHES ON CONTROL PANEL

The accessory switches are mounted on a control panel located above the radio trim plate. These switches operate the power rear window on estate wagons, the power top on convertibles, the power antenna and the courtesy light, when so equipped. See Figure 10-87.

To remove one of these switches, it is necessary to first remove the control panel.

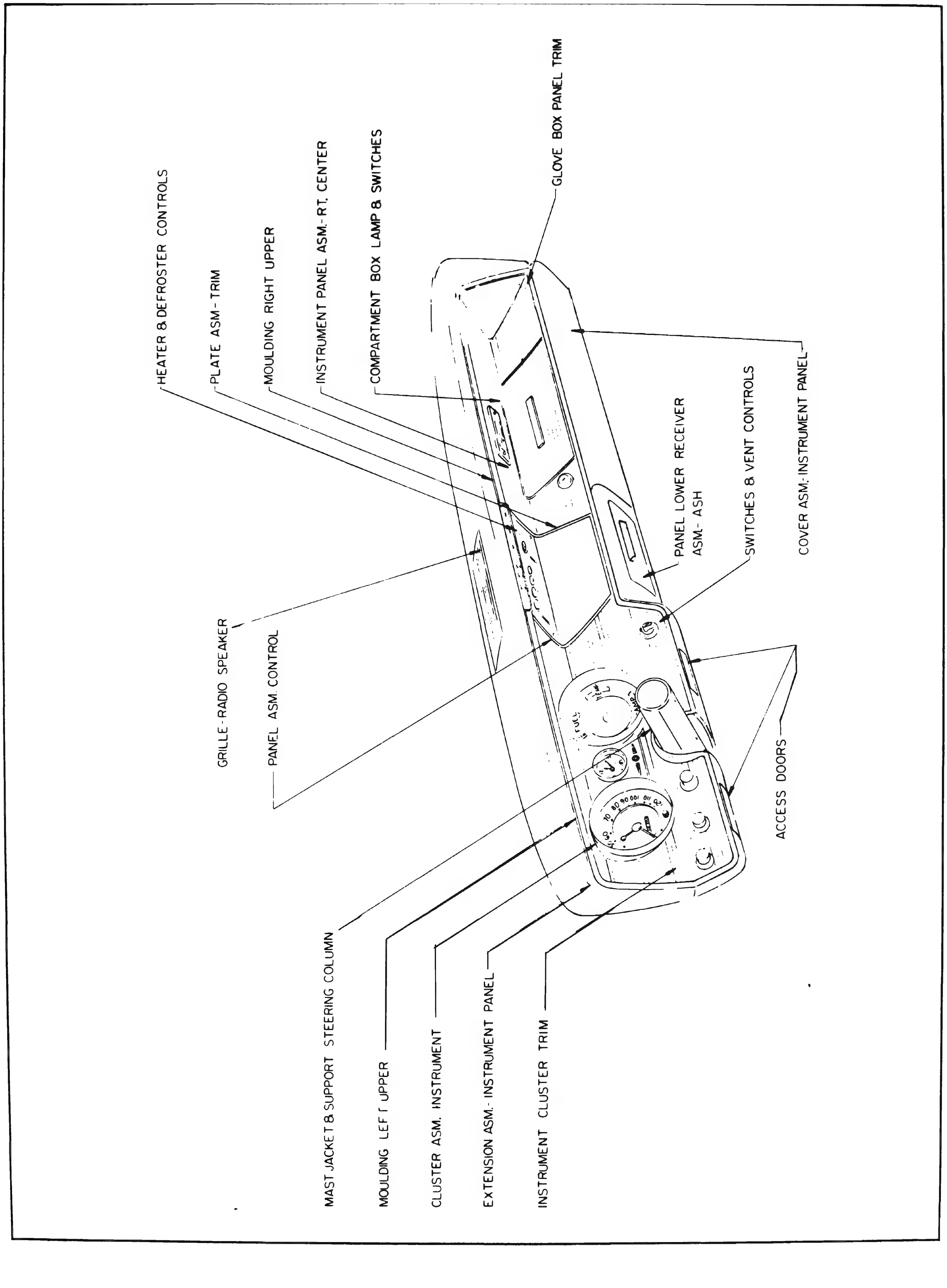


Figure 10-76—Instrument Panel Installation - Index

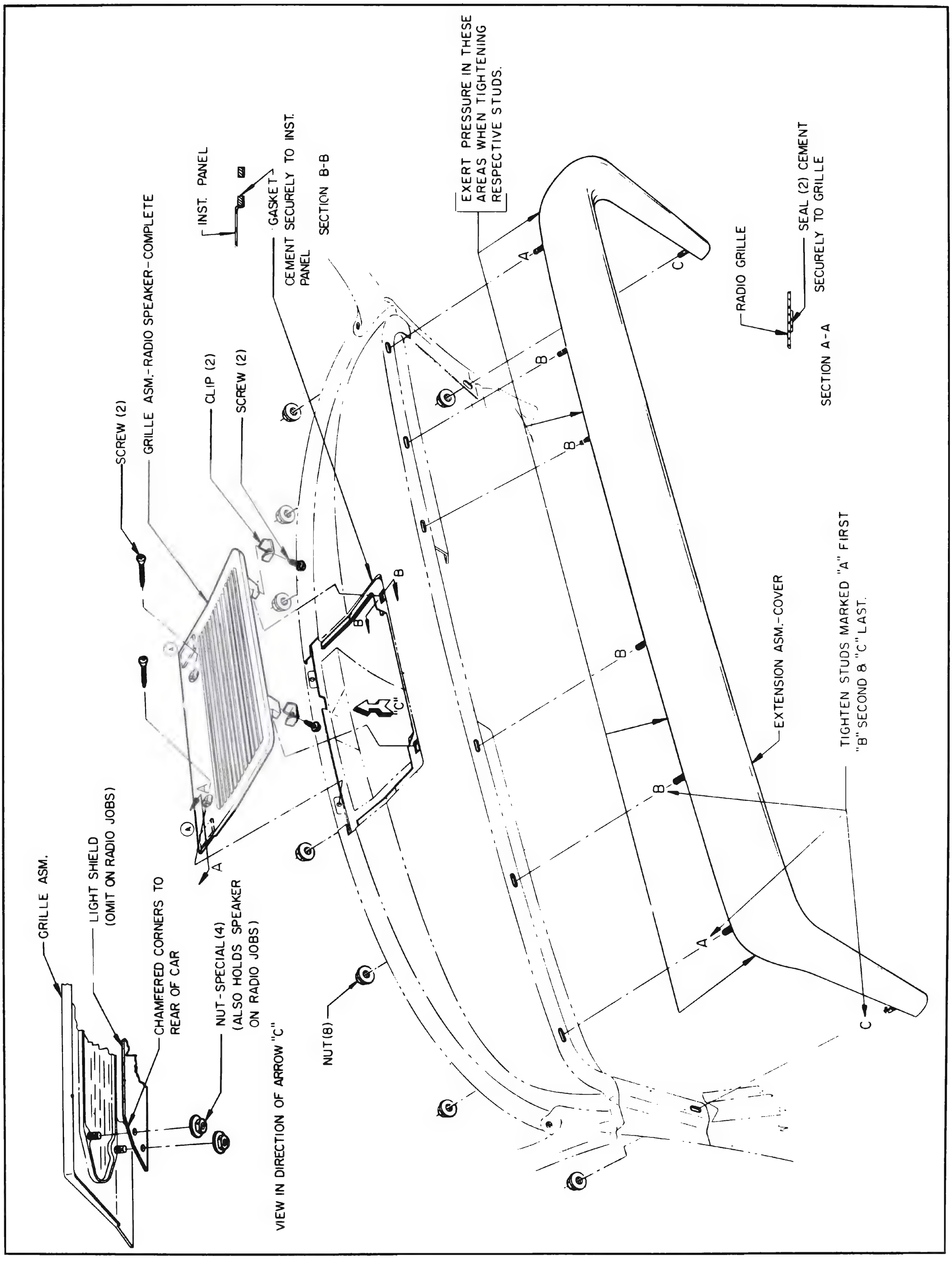


Figure 10-77—Extension and Radio Grille Installation

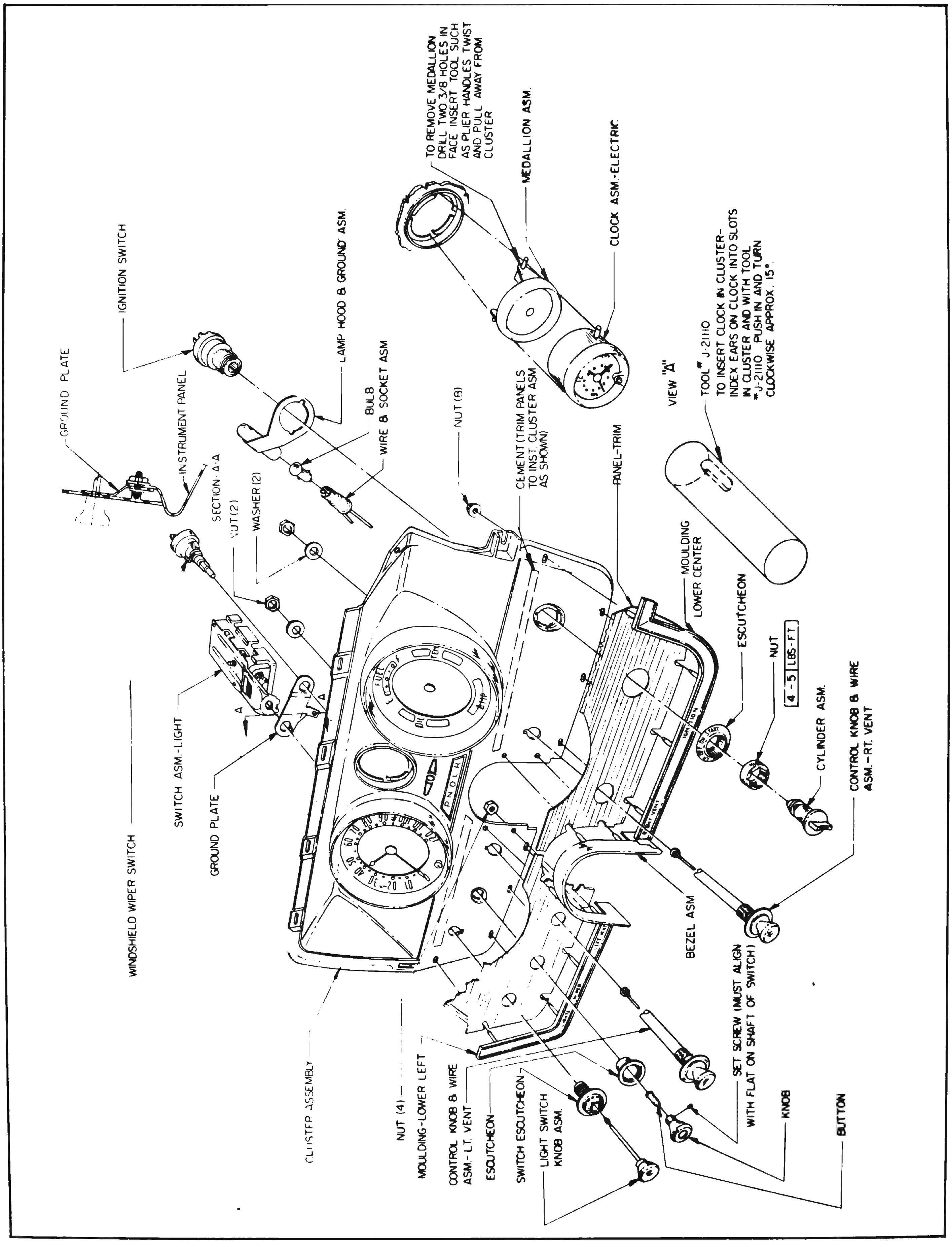


Figure 10-78—Instrument Cluster Assembly

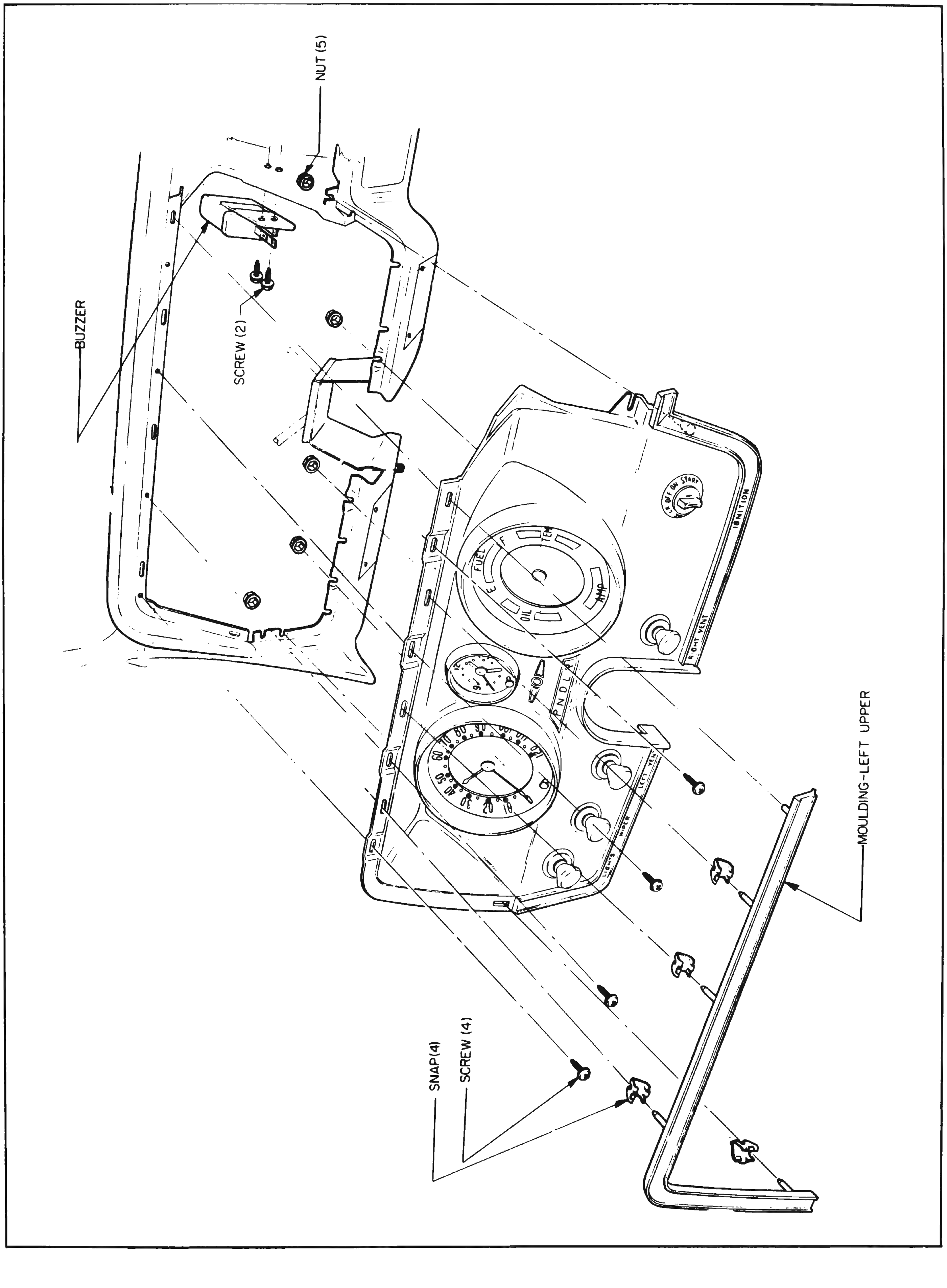


Figure 10-79—Instrument Cluster Installation

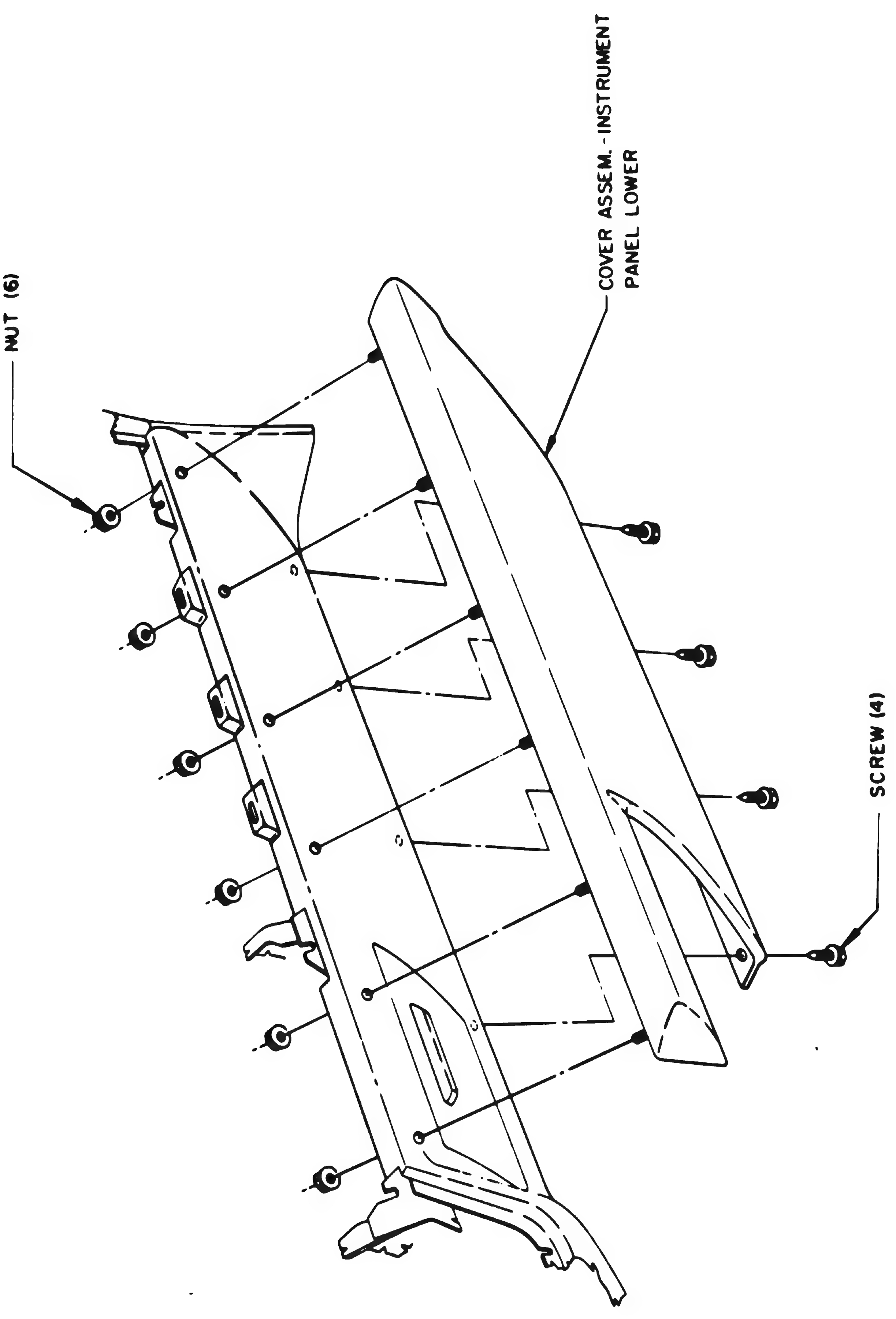


Figure 10-80—Instrument Panel Lower Cover Installation

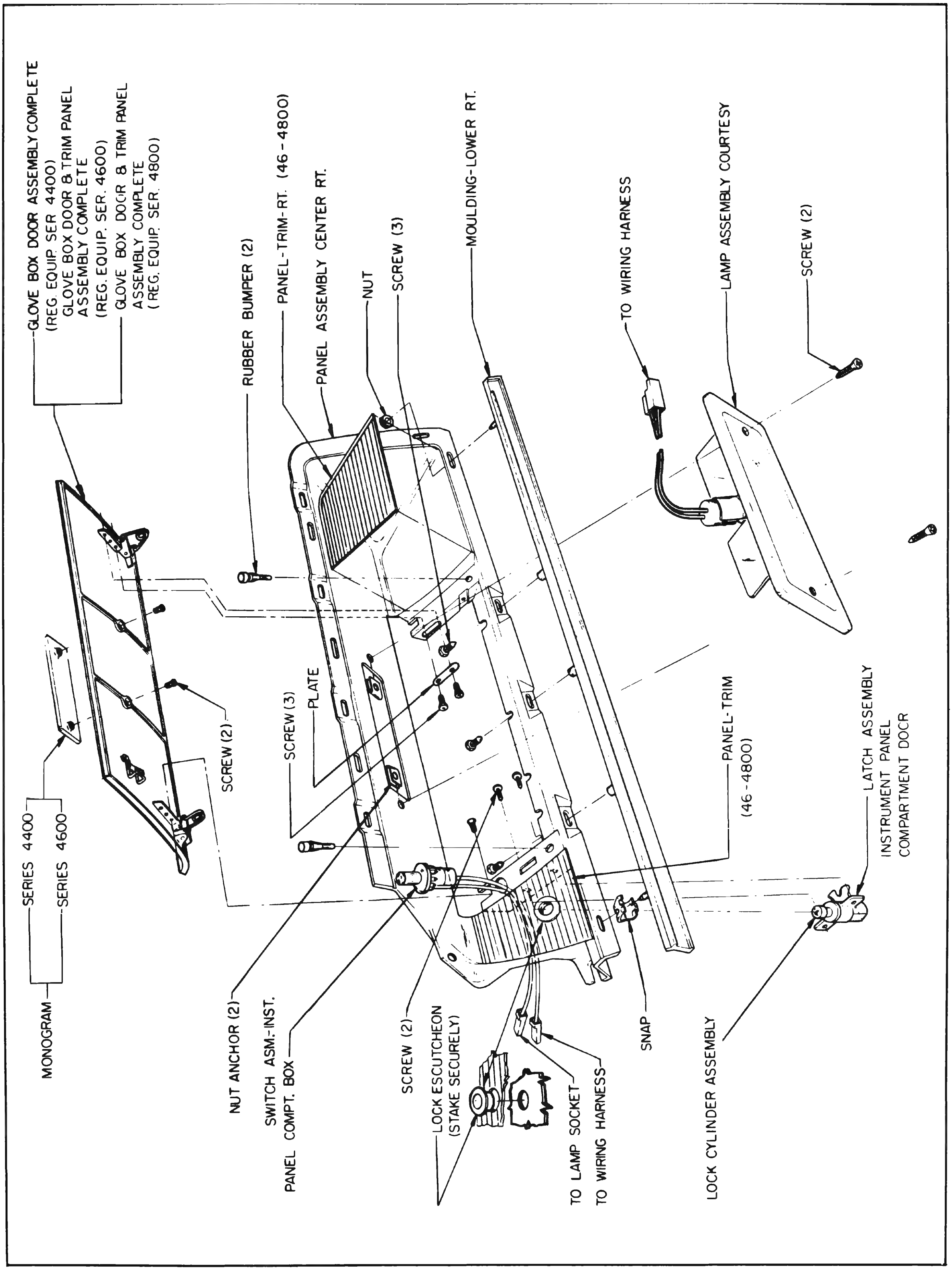


Figure 10-81—Right Center Instrument Panel Assembly

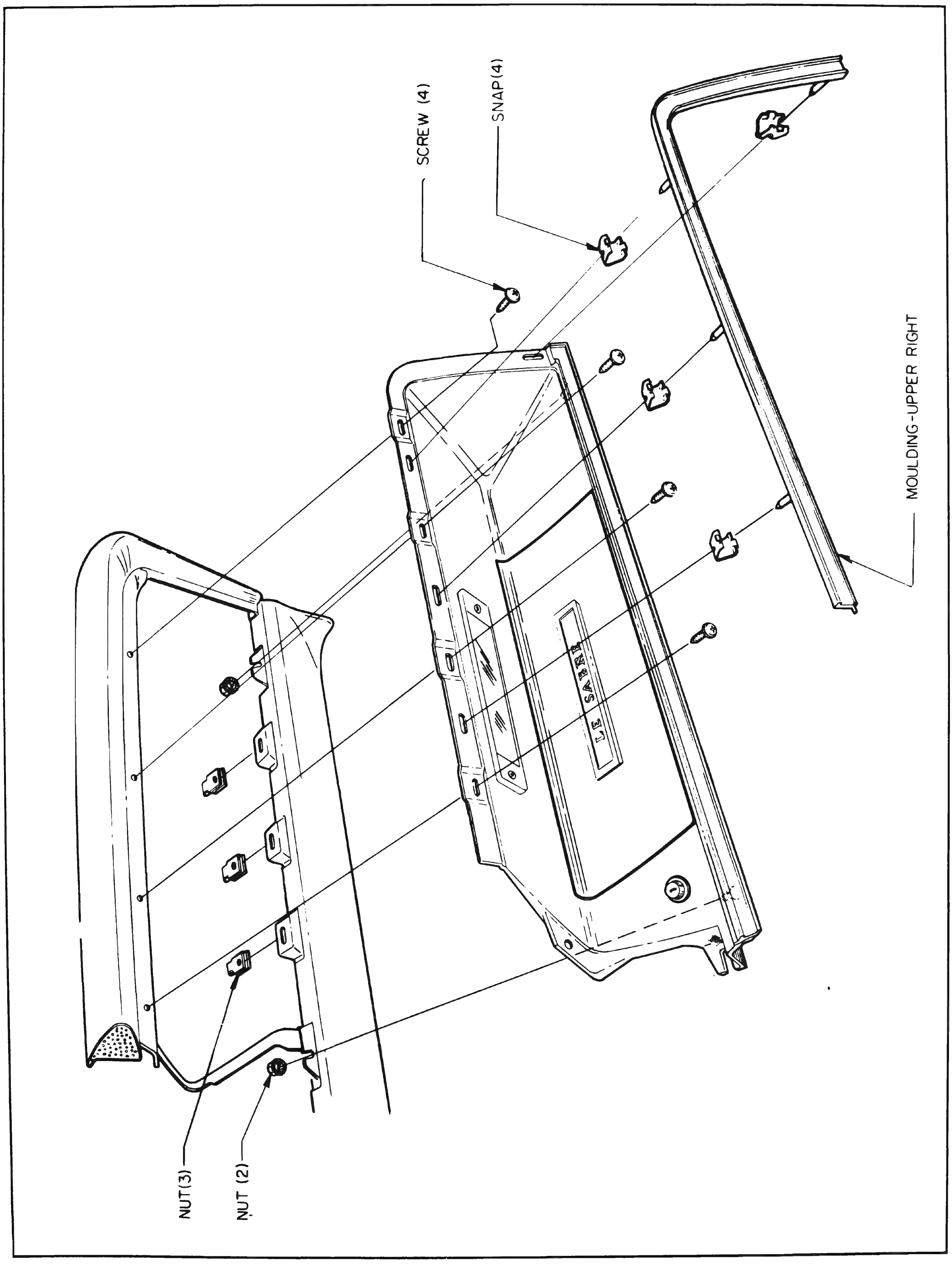


Figure 10-82—Right Center Instrument Panel Installation

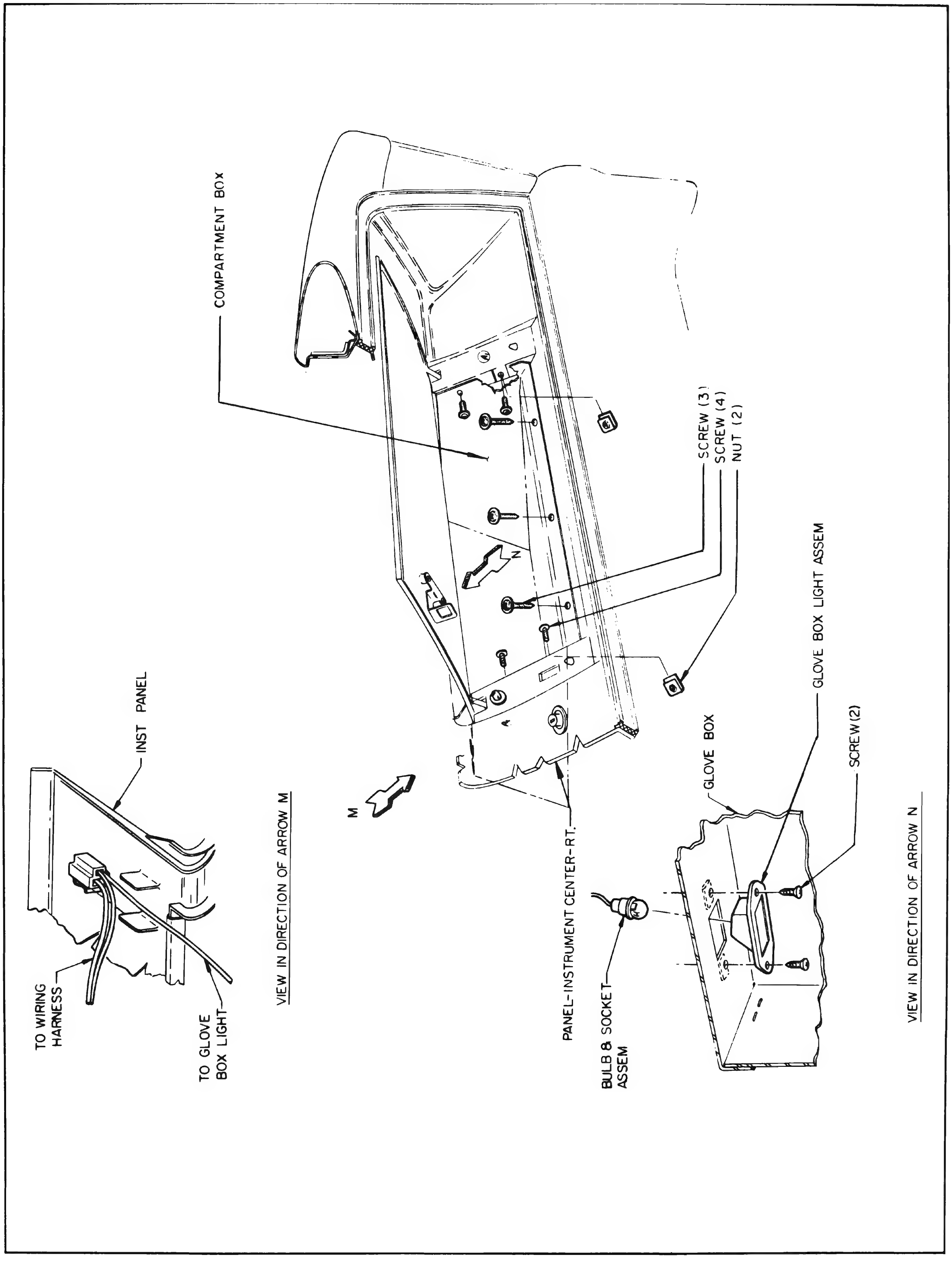


Figure 10-83—Glove Box Installation

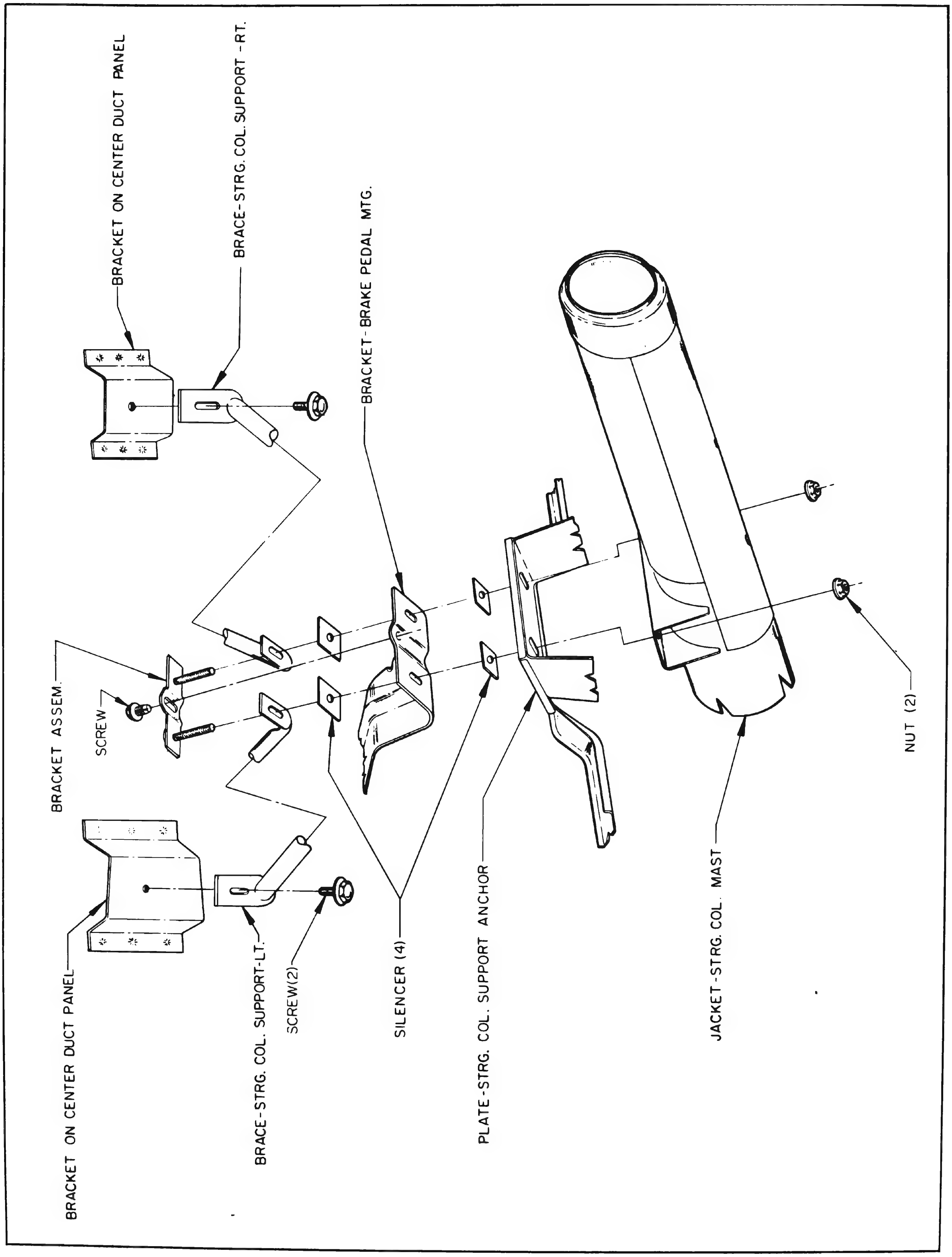


Figure 10-84—Steering Column Installation

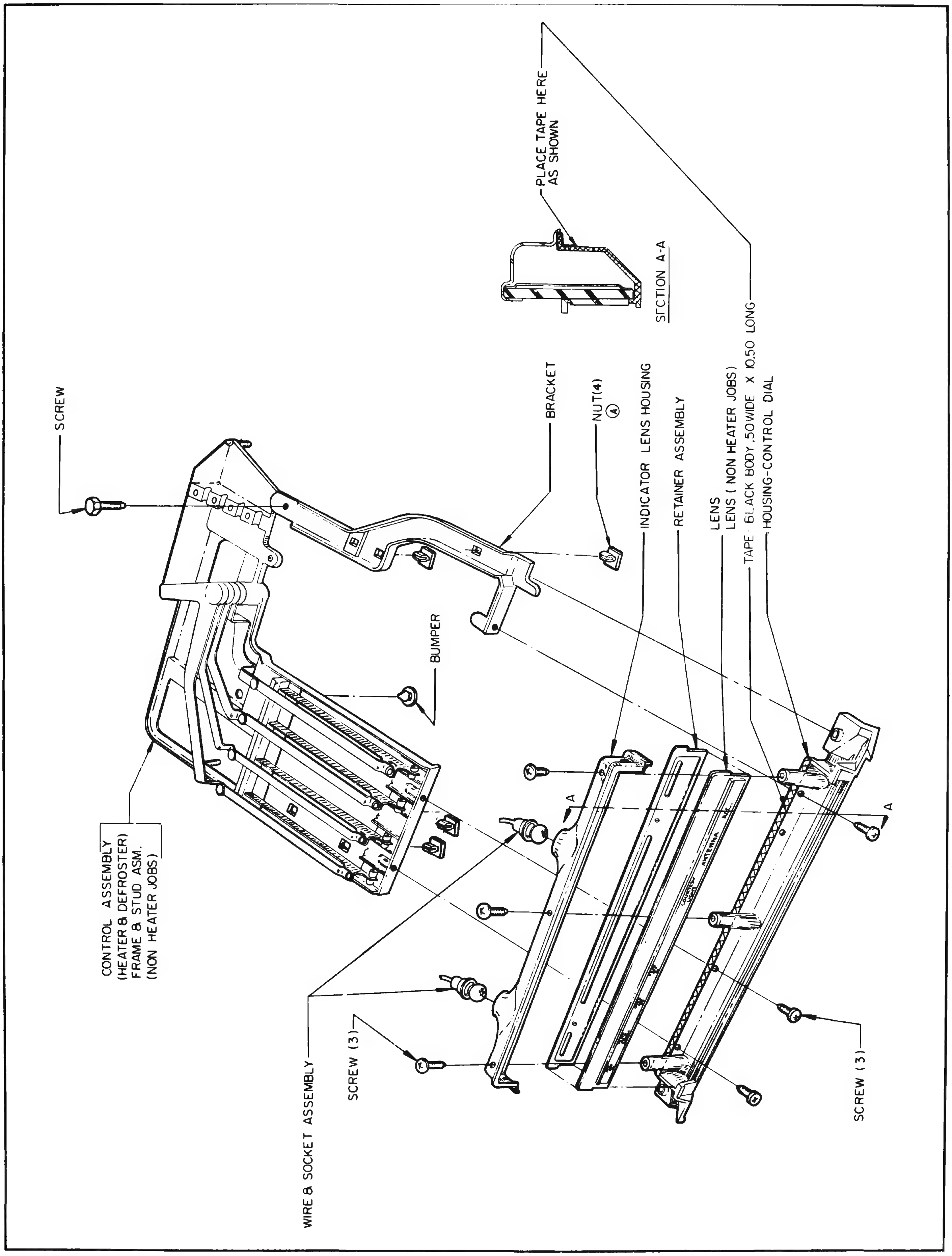


Figure 10-85—Heater Control Assembly

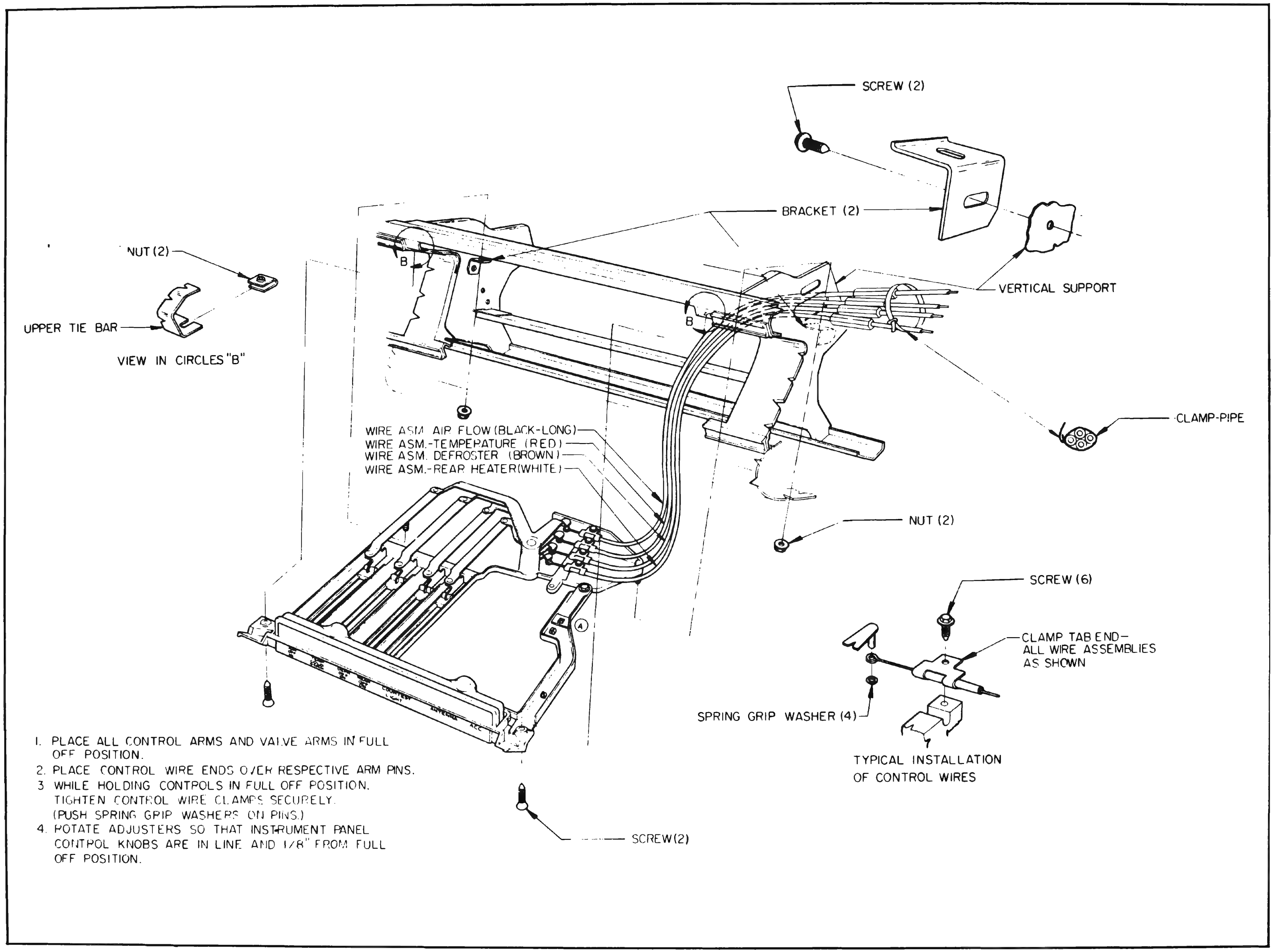


Figure 10-86—Heater Control Adjustment

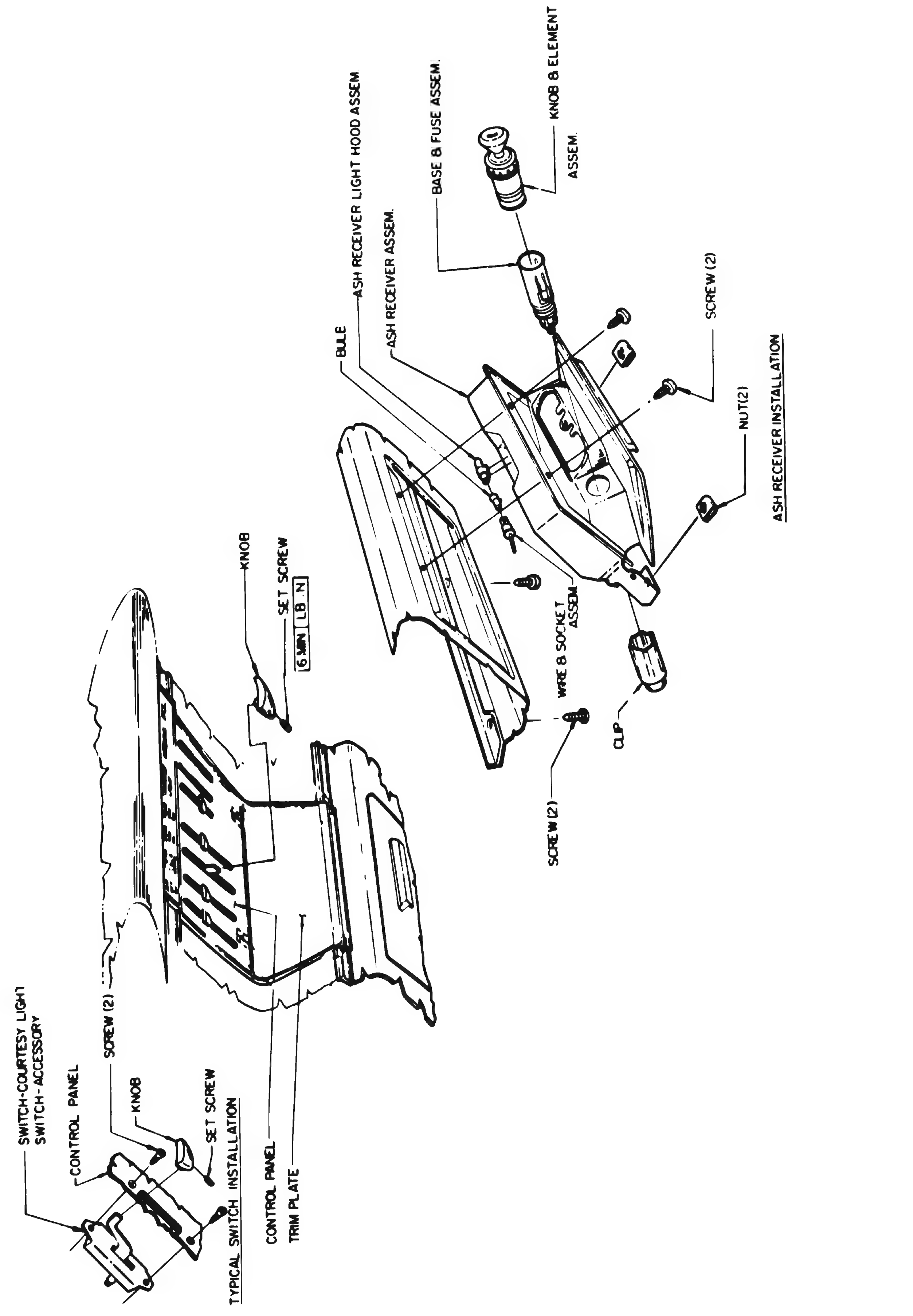


Figure 10-87—Control Panel and Ash Tray Installation

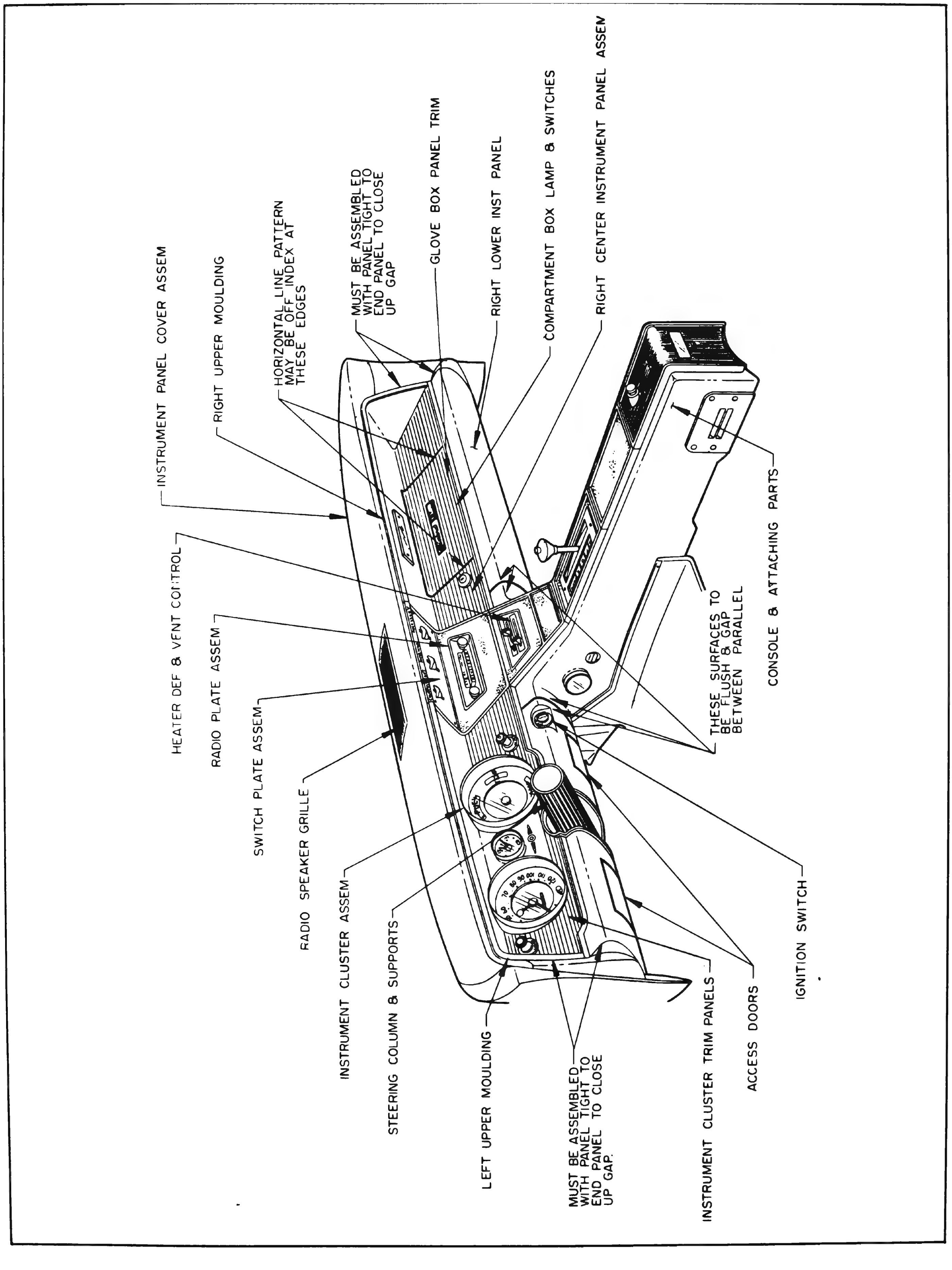


Figure 10-88—Instrument Panel and Console Installation - Index (Riviera)

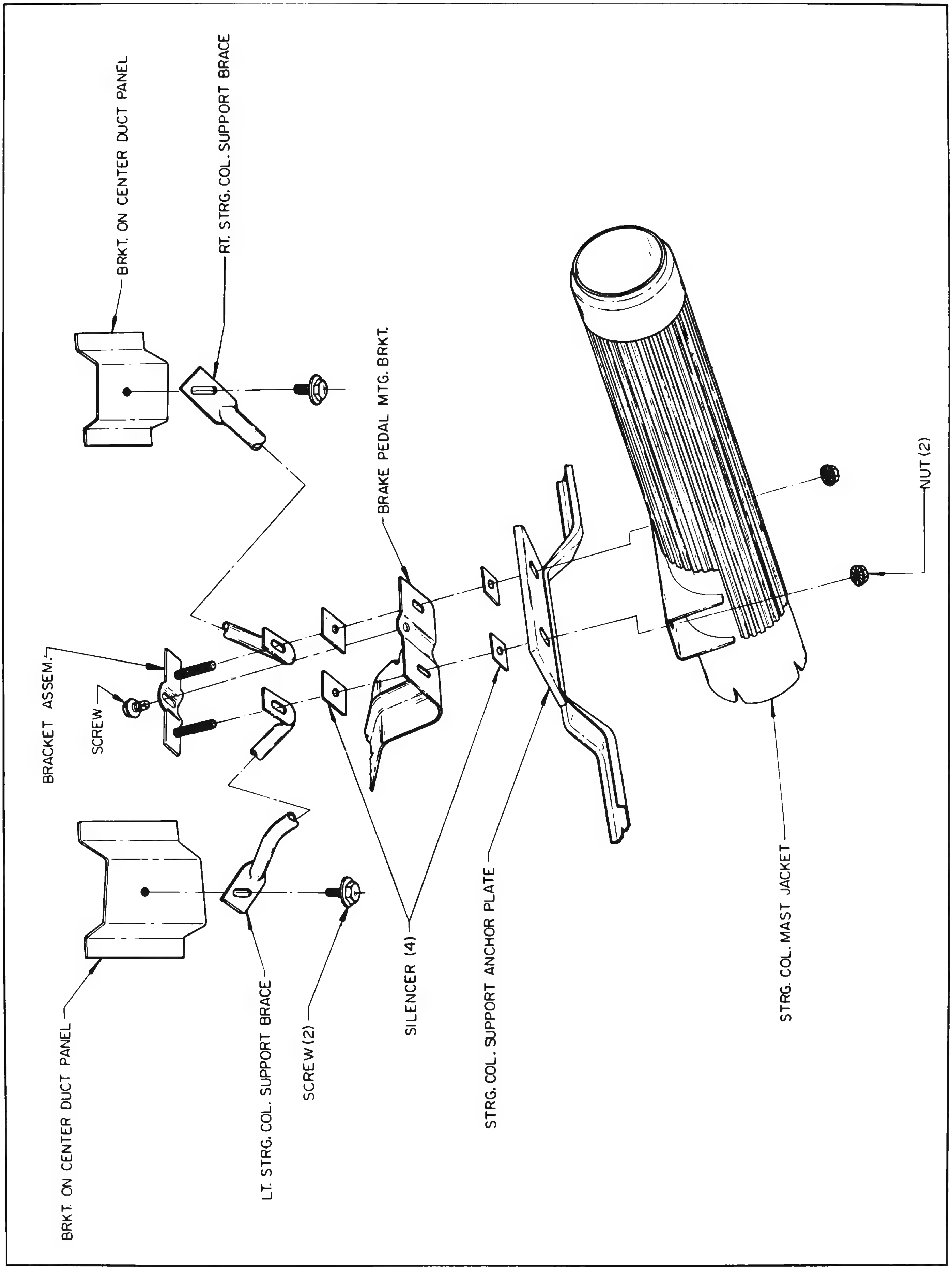


Figure 10-89—Steering Column Installation - Riviera

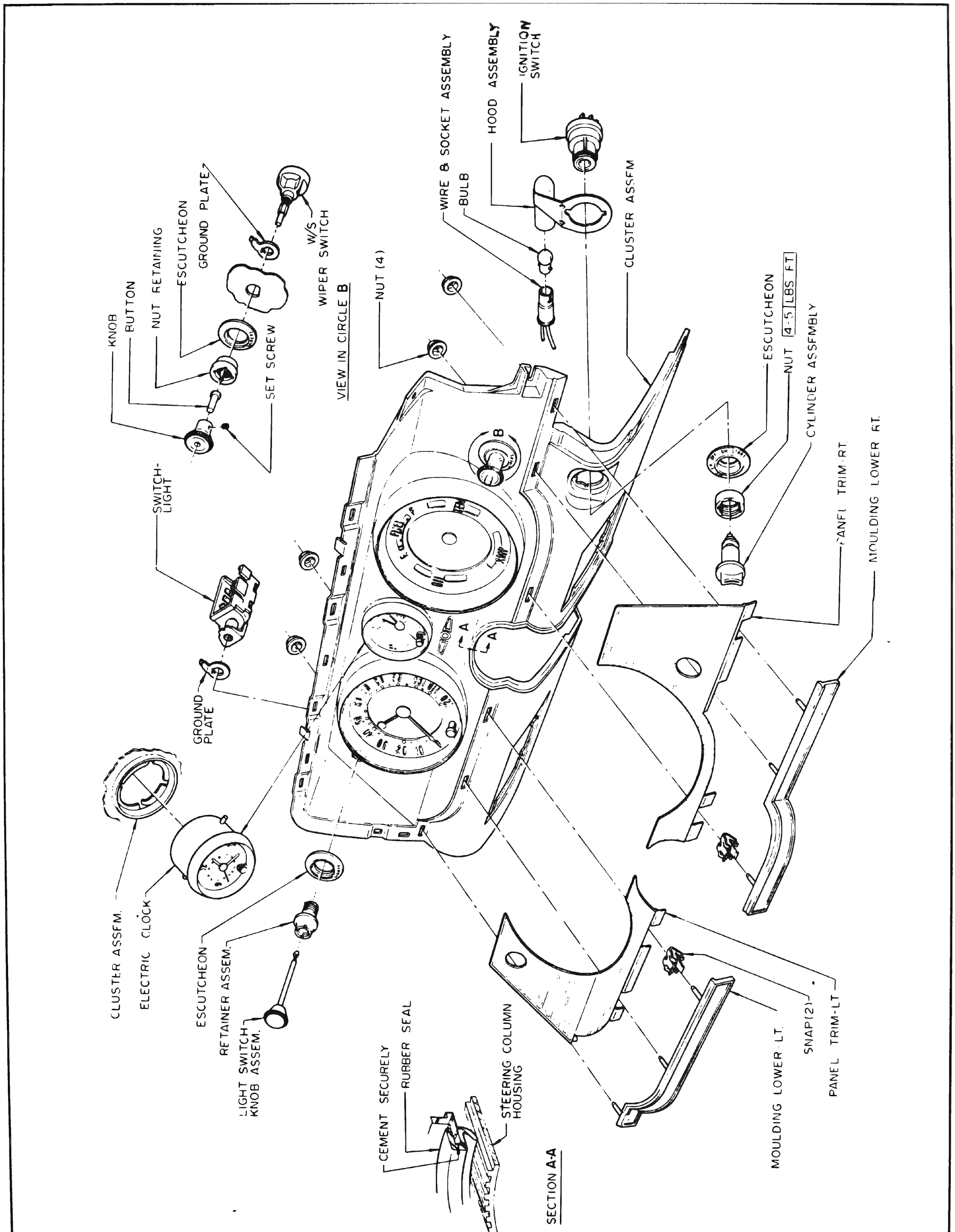


Figure 10-90—Instrument Cluster Assembly - Riviera

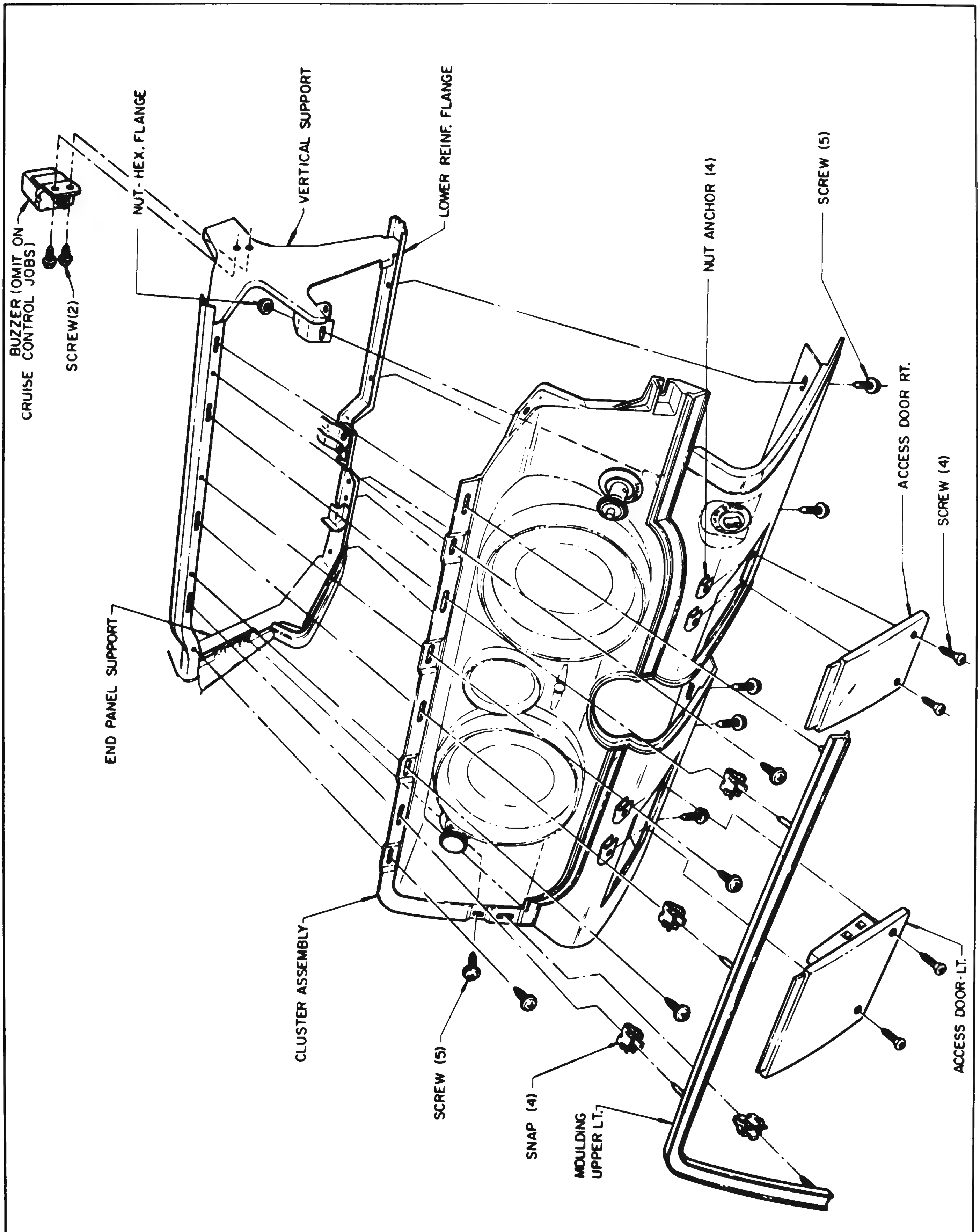


Figure 10-91—Instrument Cluster Installation - Riviera

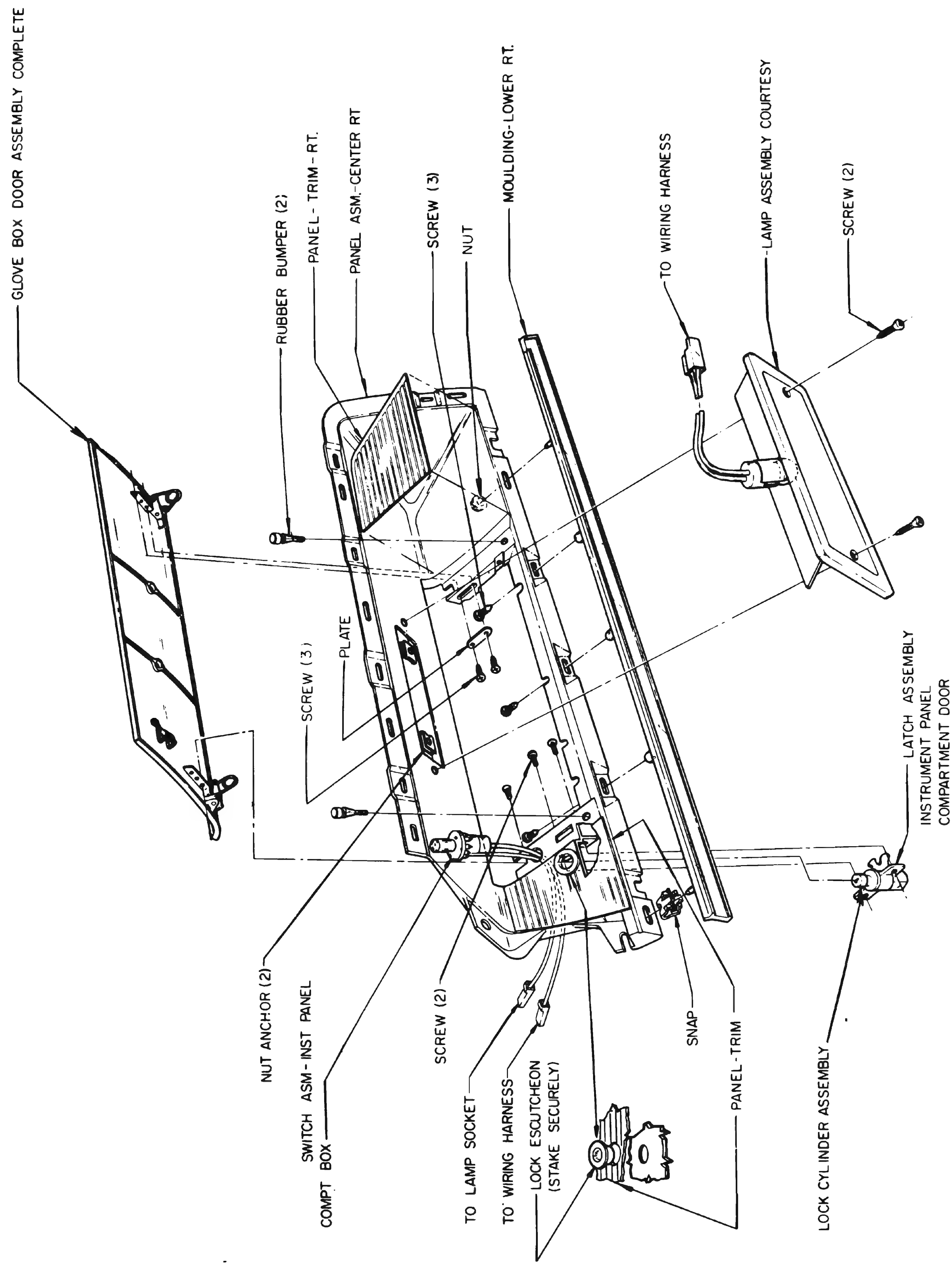


Figure 10-92—Right Center Instrument Panel Assembly - Riviera

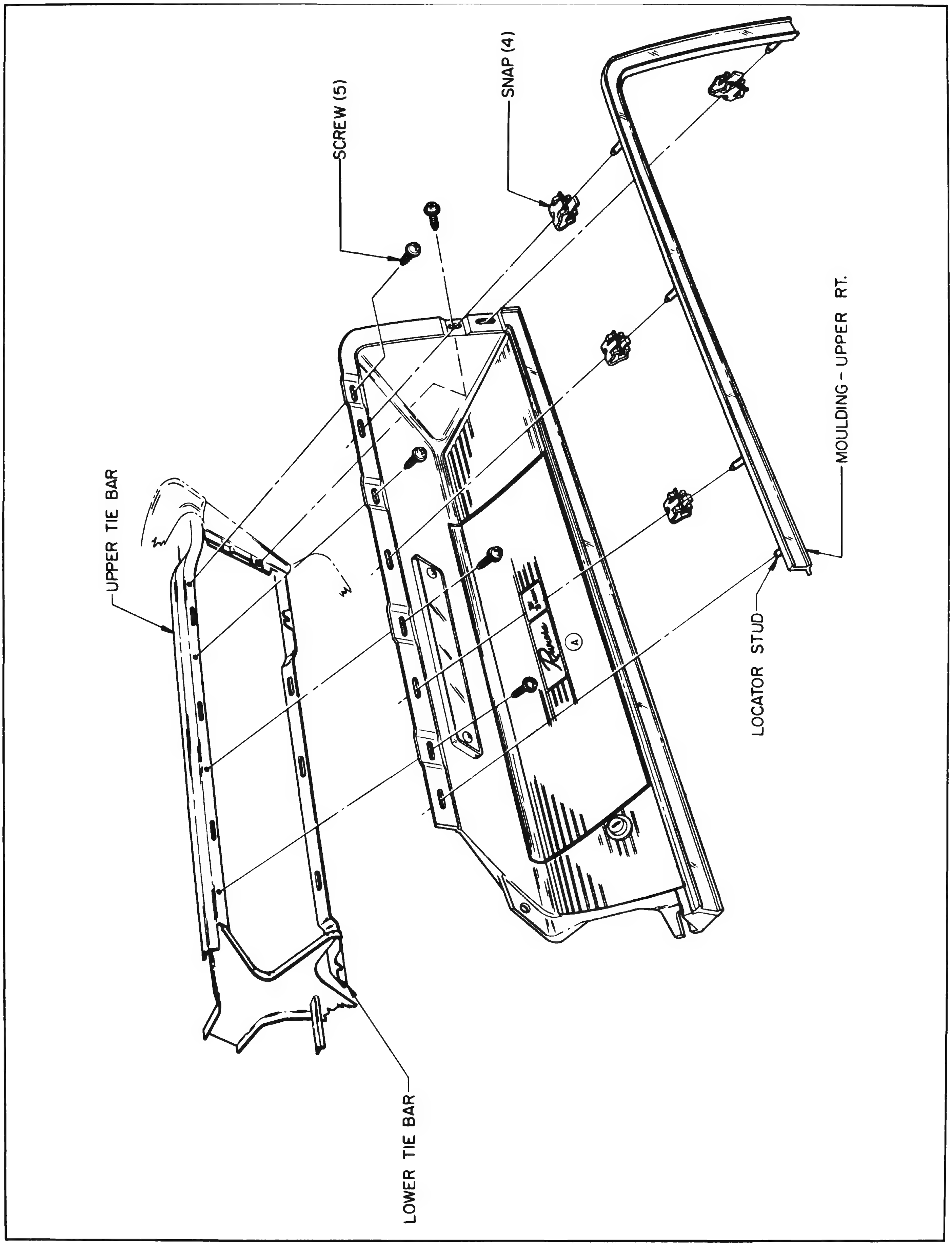


Figure 10-93—Right Center Instrument Panel Installation - Riviera

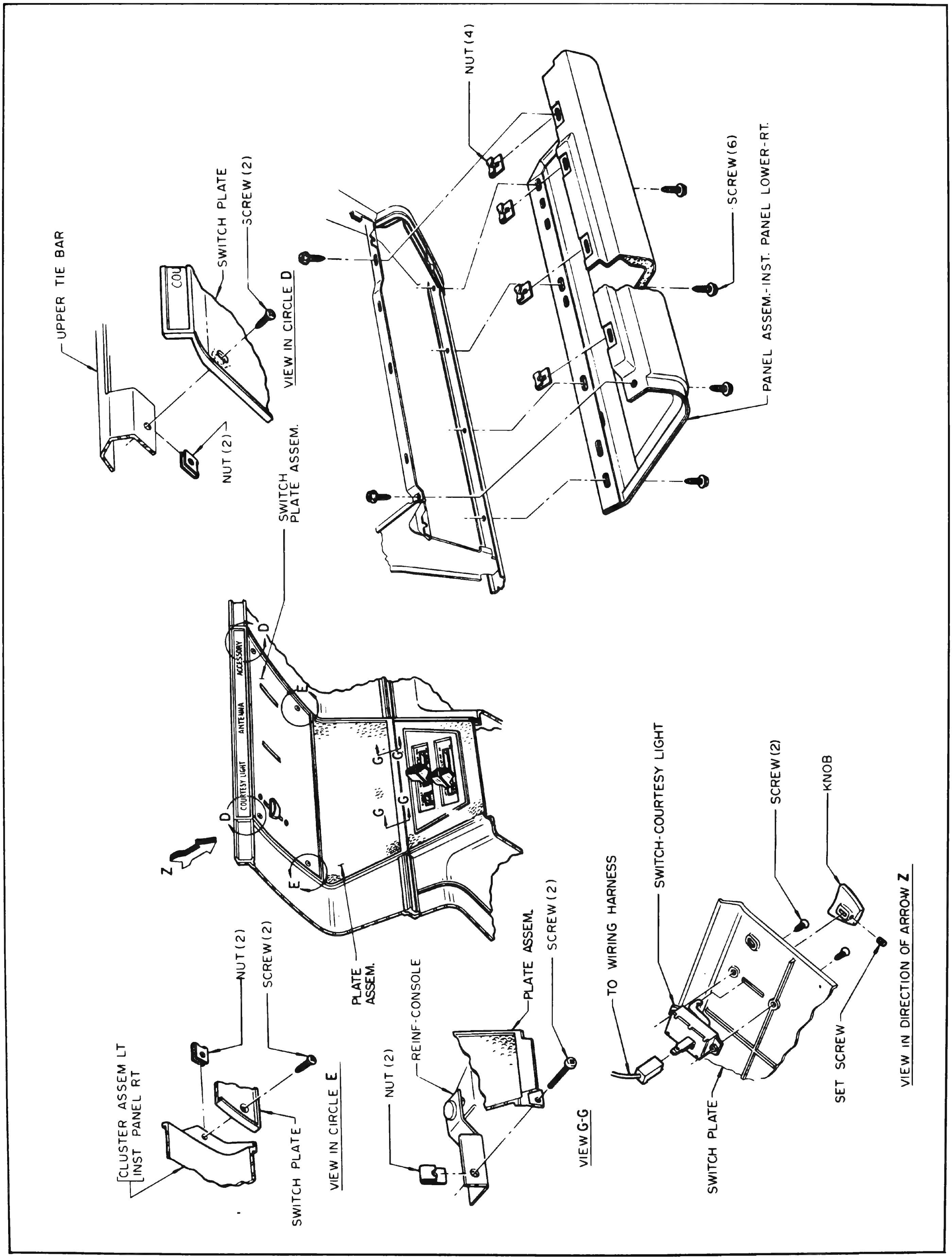


Figure 10-94—Center and Right Lower Instrument Panel Installation - Riviera

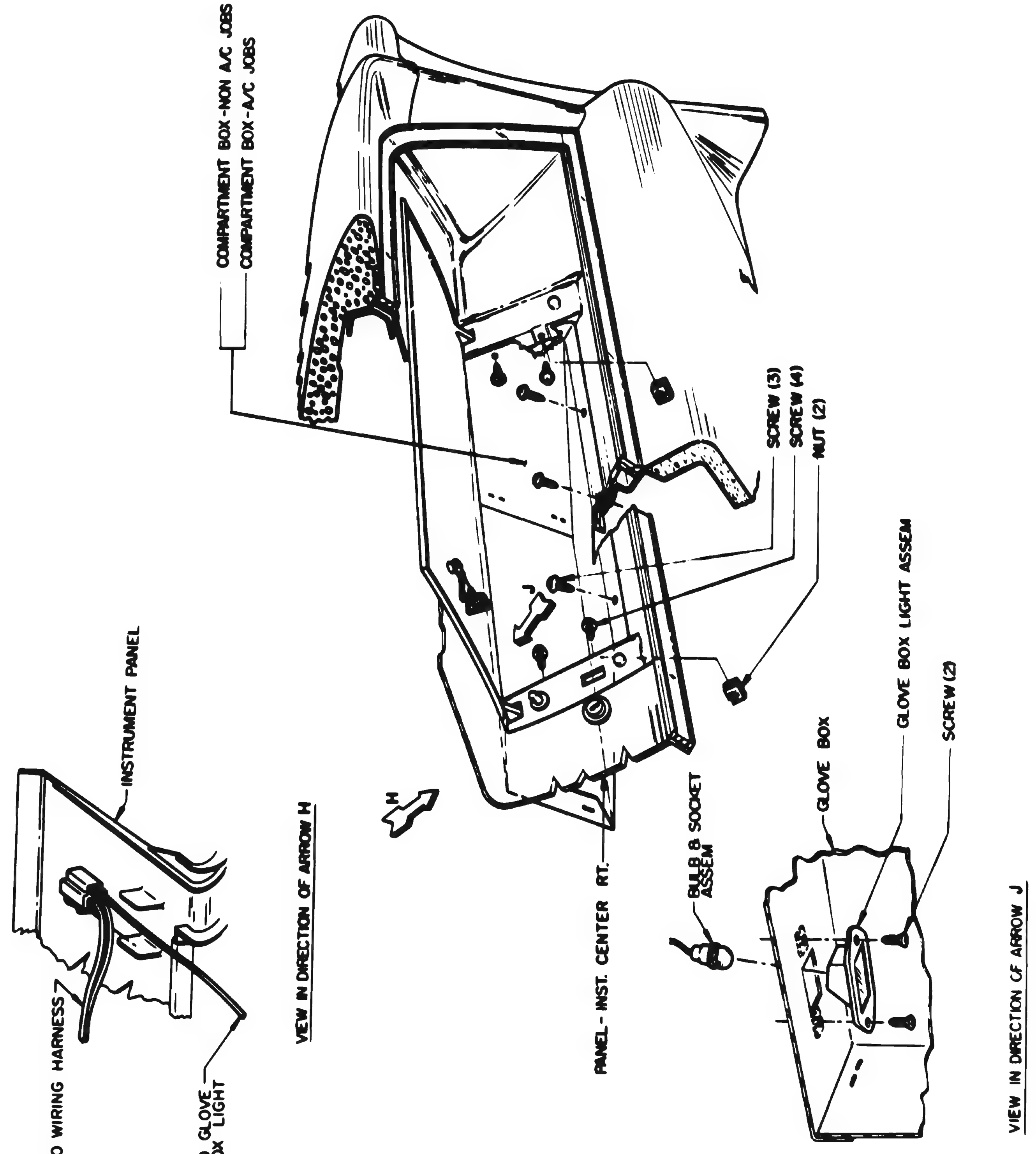


Figure 10-95—Glove Box Installation - Riviera

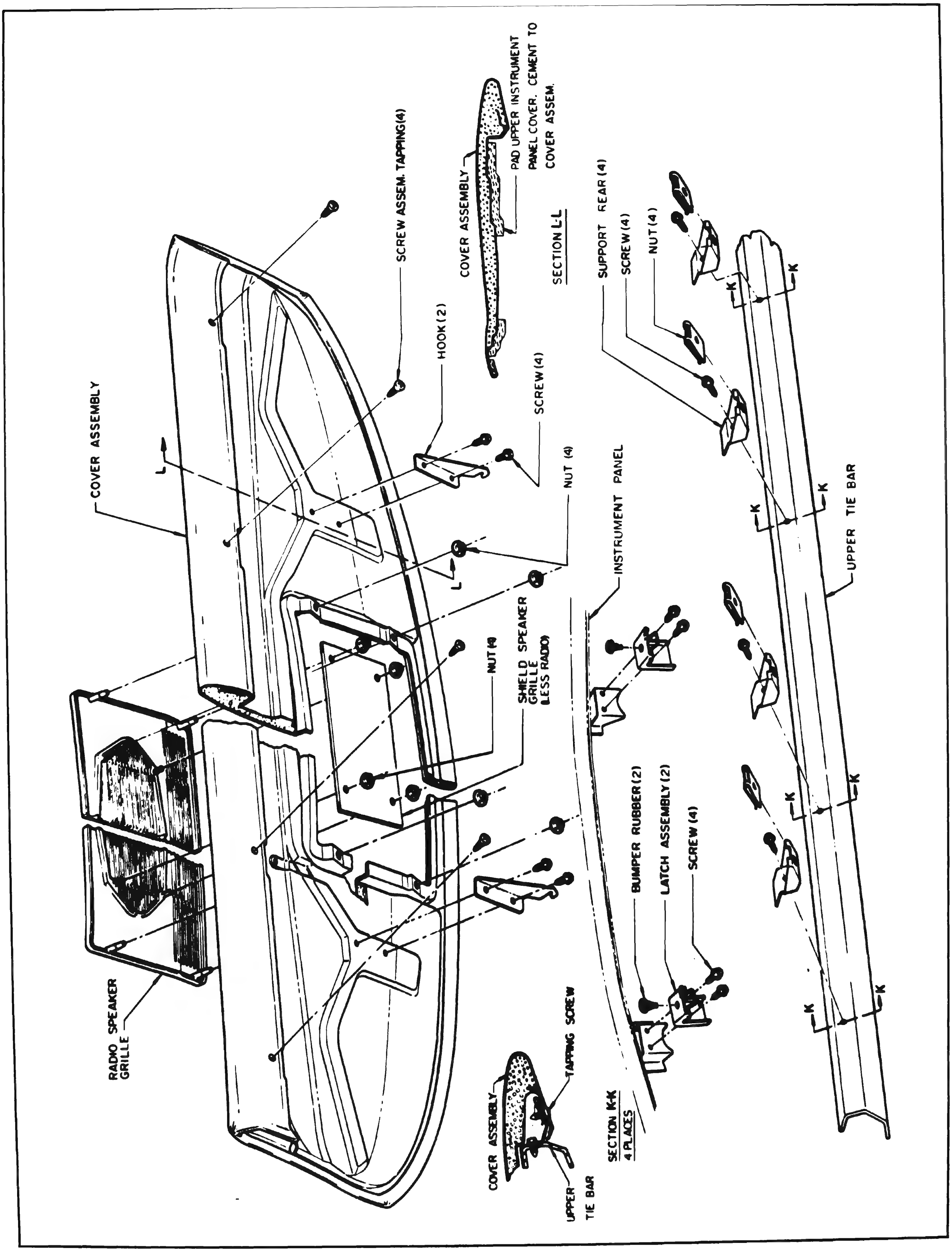


Figure 10-96—Instrument Panel Cover Assembly - Riviera

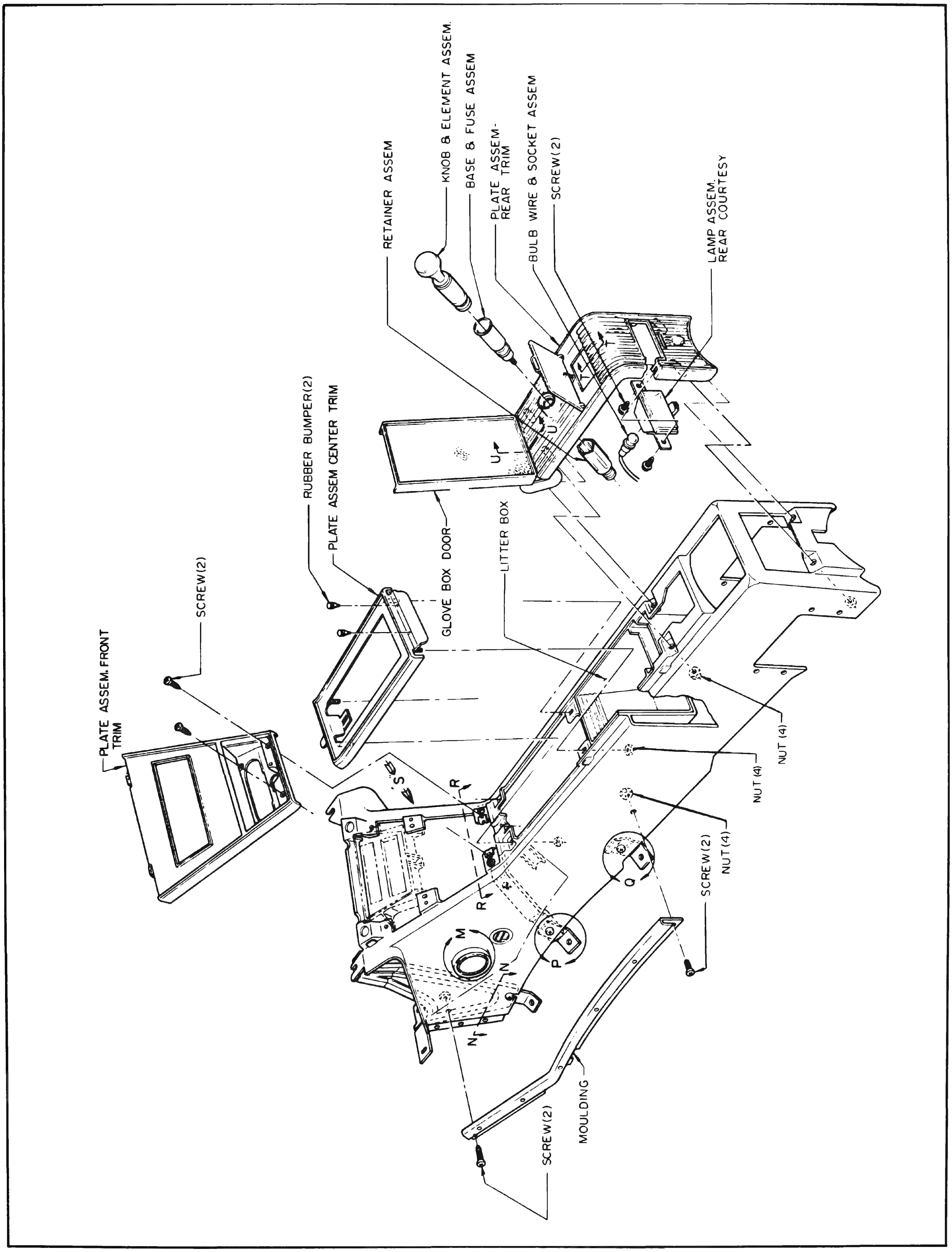


Figure 10-97—Console Assembly - Riviera

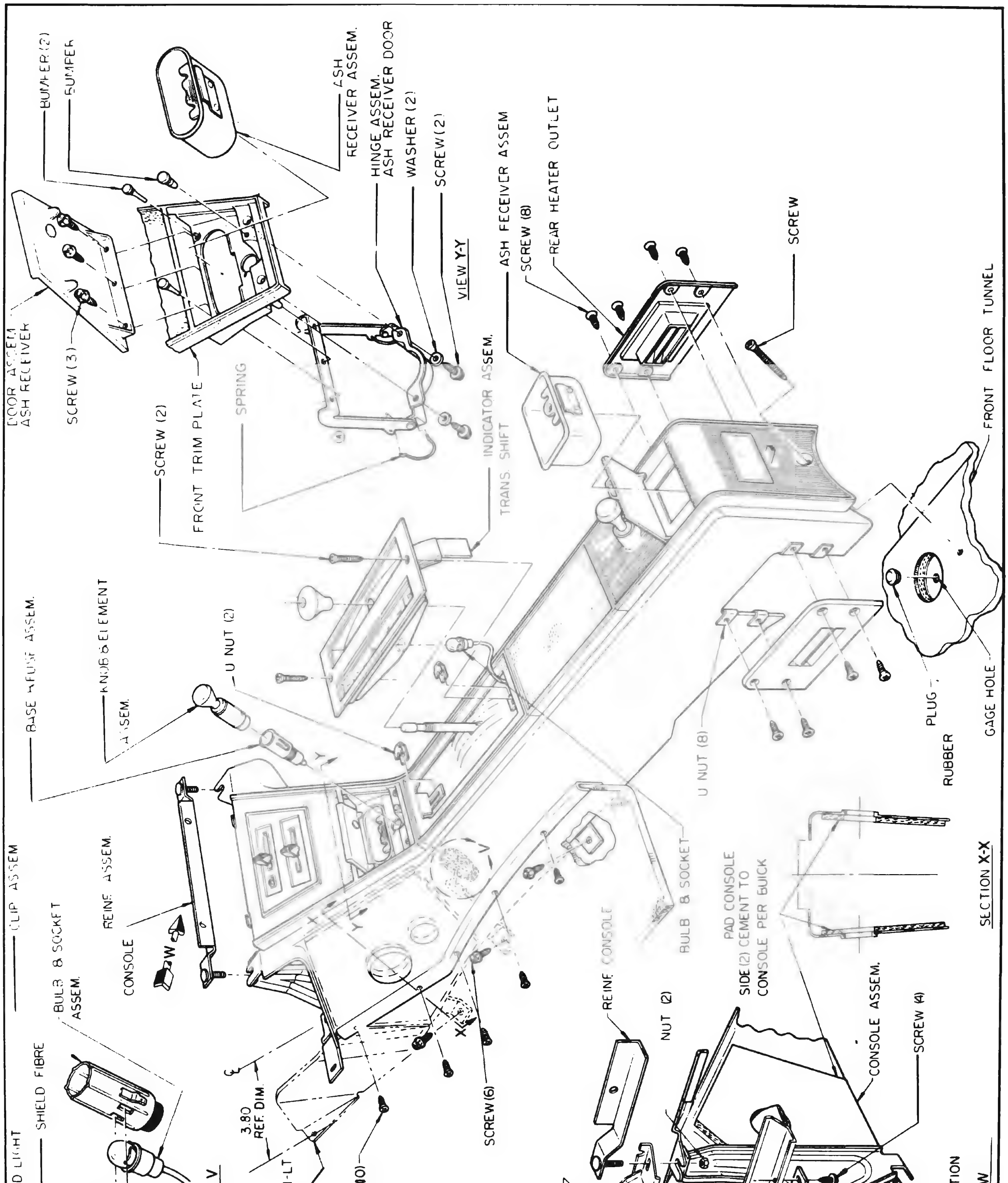


Figure 10-98—Console Installation - Riviera

SECTION 10-I

WINDSHIELD WIPER AND WASHER ASSEMBLY

CONTENTS OF SECTION 10-I

10-54 DESCRIPTION AND OPERATION—SINGLE SPEED

a. General Description

The gear train consists of a helical gear at the end of an armature shaft. The helical gear drives an intermediate gear and pinion assembly, the pinion of which drives an output gear and shaft assembly. See Figure 10-99. The crank arm is attached to the shaft of the output gear and drives the two wiper transmission through connecting link arms. See Figure 10-129 or 131.

There is no circuit breaker in this model wiper motor.

b. Principle of Operation

Two switches, a dash switch and a park switch control the starting and stopping of the wiper. The switch mounted on the dash controls starting the wiper. The park switch, which is located in the wiper gear box (Figure 10-99), controls stopping the wiper. The operation of the park switch is explained in the following paragraph. (Refer to the wiring diagram in Figure 10-101).

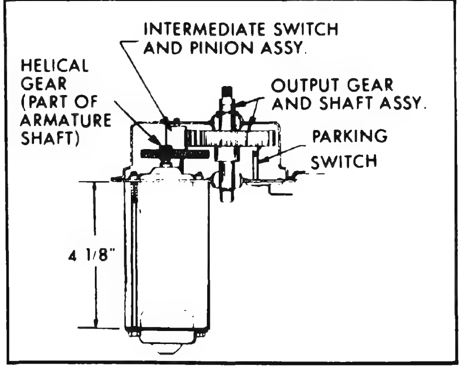


Figure 10-99—Typical View of Gear Train

When the car owner shuts the wiper "off" at the dash switch, the motor circuit to ground is opened at the dash. However, the parking switch contacts, which are normally closed, maintain the motor circuit to ground at the wiper. This allows the wiper to keep operating until the blades or wiper crank arm reach the park position (Blades approx. 2" above windshield molding). (Figure 10-100 shows the crank arm in park position.) At the same time the blades reach the park position, a cam on the output gear opens the park switch contacts. This opens the motor circuit to ground, stopping the motor. Thus, the park switch actually controls wiper operation only during that short period of time, after the owner turns the wiper "off" at the dash switch but before the wiper has completely stopped.

Turning the wiper "on" at the dash switch overrides the open park switch contacts and closes the wiper motor circuit to ground, starting the wiper. (NOTE: Although the park switch contacts are opened once during each revolution of the output gear, the park switch has no control over the wiper until the dash switch is turned "off".)

c. Connections to Operate Wiper

Figure 10-102 shows the proper method of connecting jumper leads to the wiper so that it can be operated independently of the dash switch or car wiring for test purposes. (NOTE: Specification table at end of this section lists current draw data.)

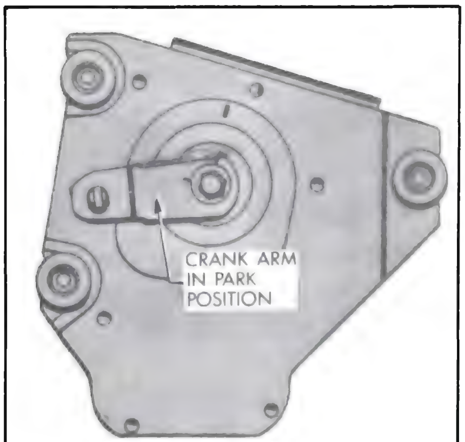


Figure 10-100—Park Position of Crank Arm

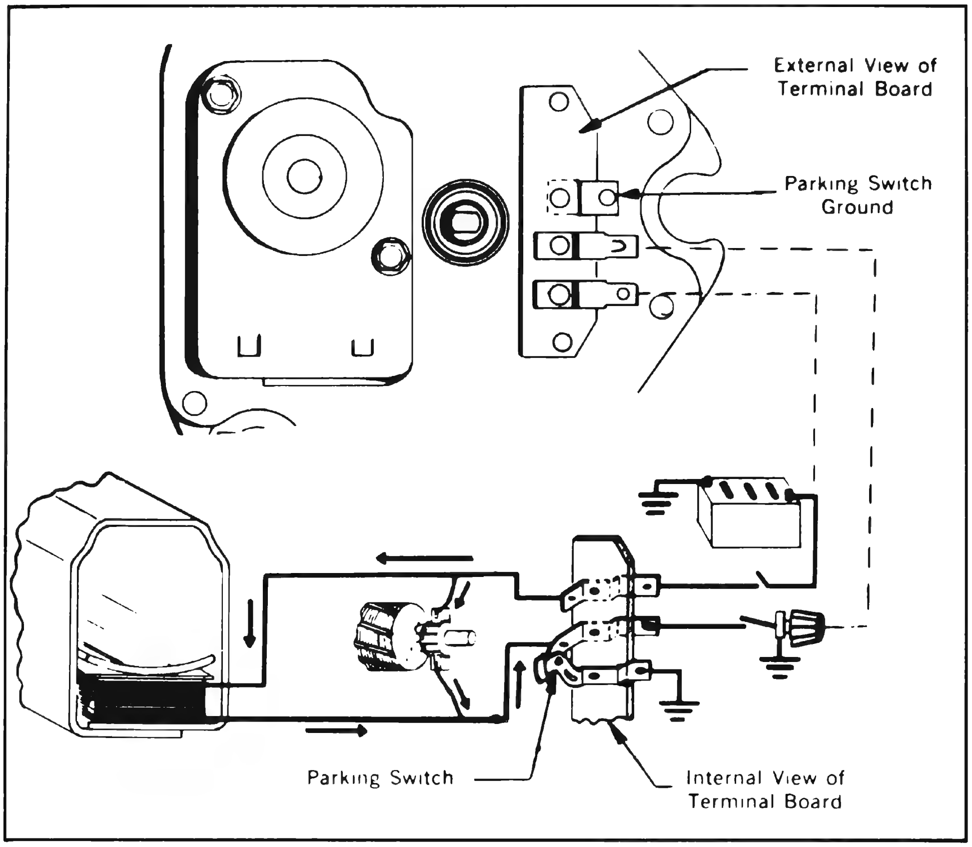


Figure 10-101—Single Speed Wiper Wiring Diagram

10-55 TROUBLE-SHOOTING—SINGLE SPEED

a. Description

Trouble-shooting procedures are divided into two categories: Wiper in car; wiper out of car.

Typical Trouble Conditions:

1. Inoperative.
2. Will not shut off.
3. Intermittent or slow operation.
4. Wiper will not park.

b. Wiper in Car

1. Wiper Inoperative - IMPORTANT: Ignition switch must be on to make electrical tests.

(a) Check the following:

(1) Make sure wiring harness is properly attached to wiper terminals and dash switch. See Figure 10-101.

(2) Make sure wiper ground strap is properly connected to wiper and car body.

(3) Make sure switch is mounted securely in dash.

(4) Check fuse.

(b) If everything checks out in Step (a) but wiper still fails to operate, disconnect wiring harness from wiper and check for 12 volts at harness terminal that connects to wiper terminal No. 2, Figure 10-102. No voltage indicates defective car wiring. CAUTION: DO NOT connect hot line to No. 1 terminal.

(c) Connect 12 volt supply to No. 2 wiper terminal and connect a jumper wire from terminal No. 1 to ground (Figure 10-102). If wiper operates, the dash switch or wiring between dash switch and wiper is defective.

(d) If wiper still fails to operate with jumper wires, remove body parts as required to disconnect wiper transmission from wiper crank arm. Recheck wiper operation with jumper wires. If wiper operates correctly a defective transmission or binding condition exists. If wiper still fails to operate, remove wiper from car and follow instructions under "Trouble-Shooting Wiper Out of Car".

2. Wiper Will Not Shut Off

(a) Disconnect wiring from dash switch. If wiper shuts off, a defective dash switch is indicated.

(b) If wiper still operates, disconnect wiring from wiper and connect 12 volt supply direct to

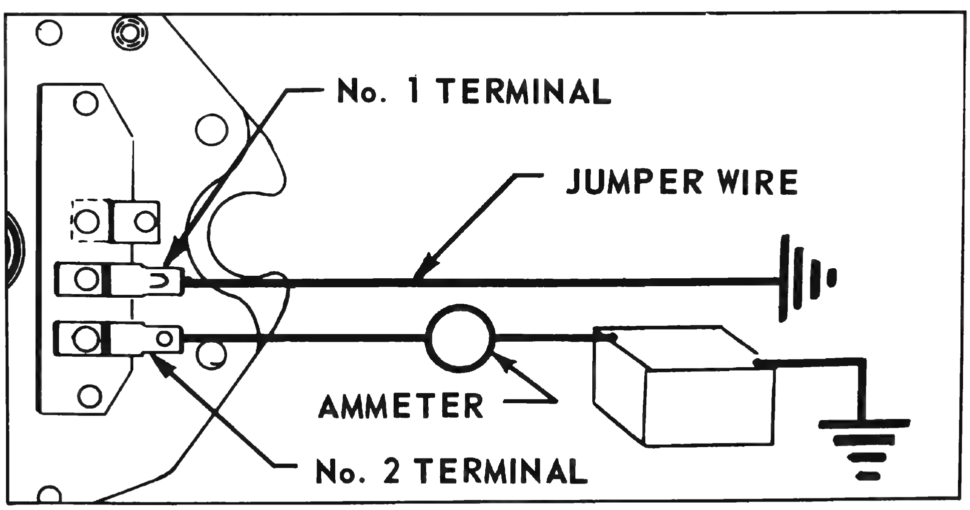


Figure 10-102—Connections to Operate Wiper Out of Car

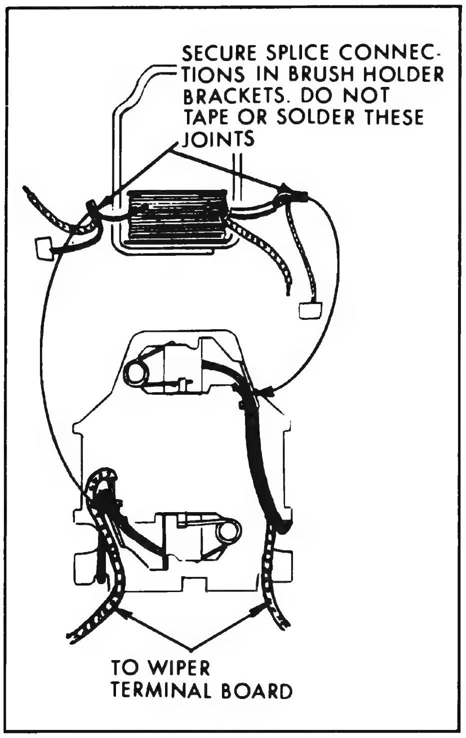


Figure 10-103—Motor Wiring

wiper terminal No. 2 (Figure 10-102). DO NOT connect any jumper wire to terminal No. 1.

If wiper now shuts off correctly, check for a ground in lead that extends between wiper terminal No. 1 and dash switch.

If wiper still fails to shut off-remove wiper from car and follow instructions under "Trouble-Shooting Wiper Out of Car".

3. Intermittent or Slow Operation

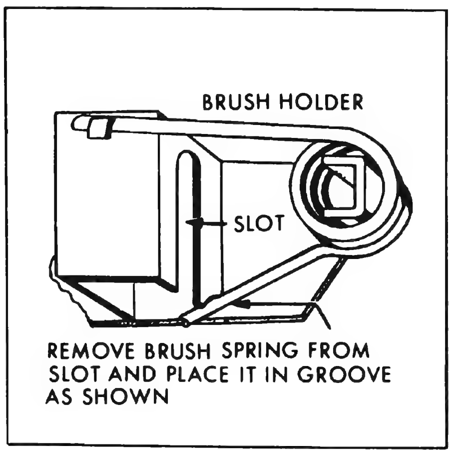


Figure 10-104—Releasing Brush Holder Spring Pressure

(a) Check the following: Loose ground strap, loose dash switch mounting, loose connection.

4. Wiper Will Not Park

(a) Remove wiper from car and check for a dirty or broken park switch.

c. Wiper Out of Car

Connect a 12 volt supply and an ammeter to wiper as shown in Figure 10-102 and observe current draw and wiper operation.

1. Wiper Inoperative

(a) Current Draw - 0.

(1) Check solder connection at terminal board.

(2) Disassemble motor section and check all splice connections (Figure 10-103).

(b) Current Draw - 1-1.5 amps.- Disassemble motor and check for the following items:

(1) Open armature.

(2) Brushes sticking.

(3) Brush springs improperly positioned (See Figure 10-104).

(4) Brush pigtail connections at splice joints (Figure 10-103).

(c) Current Draw - 10-12 amps.

(1) Check for open shunt field circuit.

(2) Check for broken gear.

2. Wiper Will Not Shut Off.

Wiper crank arm fails to stop in park position when jumper wire is removed from wiper terminal No. 1 (Figure 10-102).

(a) Check that park switch contacts are opening.

(b) Check for grounded condition in the internal motor lead that connects to terminal No. 1, Figure 10-102.

3. Intermittent or Slow Operation

(a) Current Draw - 7-9 amps.

(1) Check for binds in gear train.

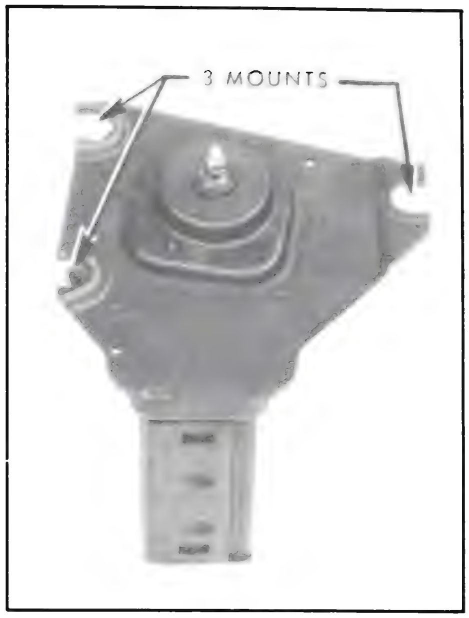


Figure 10-105—Single Speed Wiper

(2) Check for shorted armature. (Armature may be checked on a growler).

4. Wiper Will Not Park.

Wiper crank arm stops rotating immediately when jumper wire is disconnected from wiper terminal No. 1 (Figure 10-102). NOTE: Crank arm should continue to rotate until park position is reached (Figure 10-100).

10-56 DISASSEMBLY AND ASSEMBLY— SINGLE SPEED

a. Gear Box Disassembly

1. Remove washer pump drive cam as required (Figure 10-105). The cam is pressed on the shaft but can be wedged off by using two screwdrivers between cam and plate.

2. Clamp crank arm in a vise and loosen crank arm retaining nut.

3. Remove seal cap, retaining ring and end-play washer. NOTE: Seal cap should be cleaned and repacked with a waterproof type grease before reassembly.

4. Drill out the gear box cover retaining rivets and remove cover from gear train. CAUTION: Mark ground strap location for reassembly purposes.

5. Remove output gear and shaft assembly, then slide intermediate gear and pinion assembly off shaft. (Figure 10-106).

6. Remove terminal board and park switch assembly as follows:

(a) Unsolder motor leads from terminals.

(b) Drill out rivets that secure terminal board and park switch ground strap to plate.

NOTE: Screws, nuts and washers for attaching a replacement terminal board-park switch assembly are included with the replacement assembly.

b. Gear Box Assembly

Reverse Steps 1 thru 7 except as noted:

1. Reassembly of Gear Box Cover - Be sure cover is located properly over locating dowel pins and be sure to reinstall ground strap.

2. Reassembly of Crank Arm - Operate wiper to park position (Figure 10-102) and install crank arm on output shaft in the position shown in Figure 10-100. Clamp crank in vise before securing the retaining nut.

c. Motor Disassembly and Assembly

1. Follow Steps 1 thru 7(a) under gear box disassembly.

2. Release brush spring pressure against brushes as shown in Figure 10-104.

3. Move brushes away from armature and slide armature out of frame and field assembly. Pull end cap assembly off armature. See Figure 10-107.

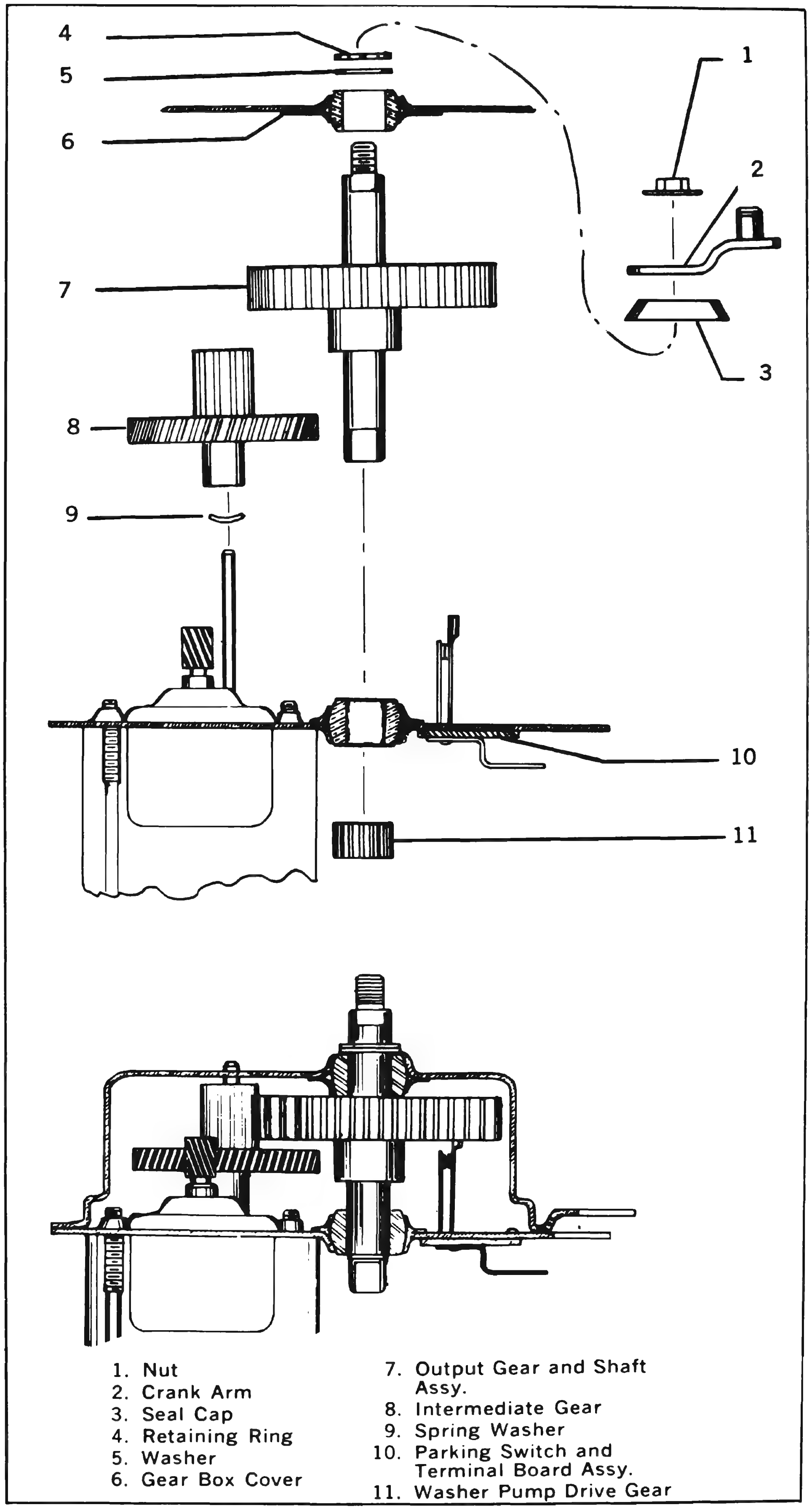


Figure 10-106—Gear Box Assembly

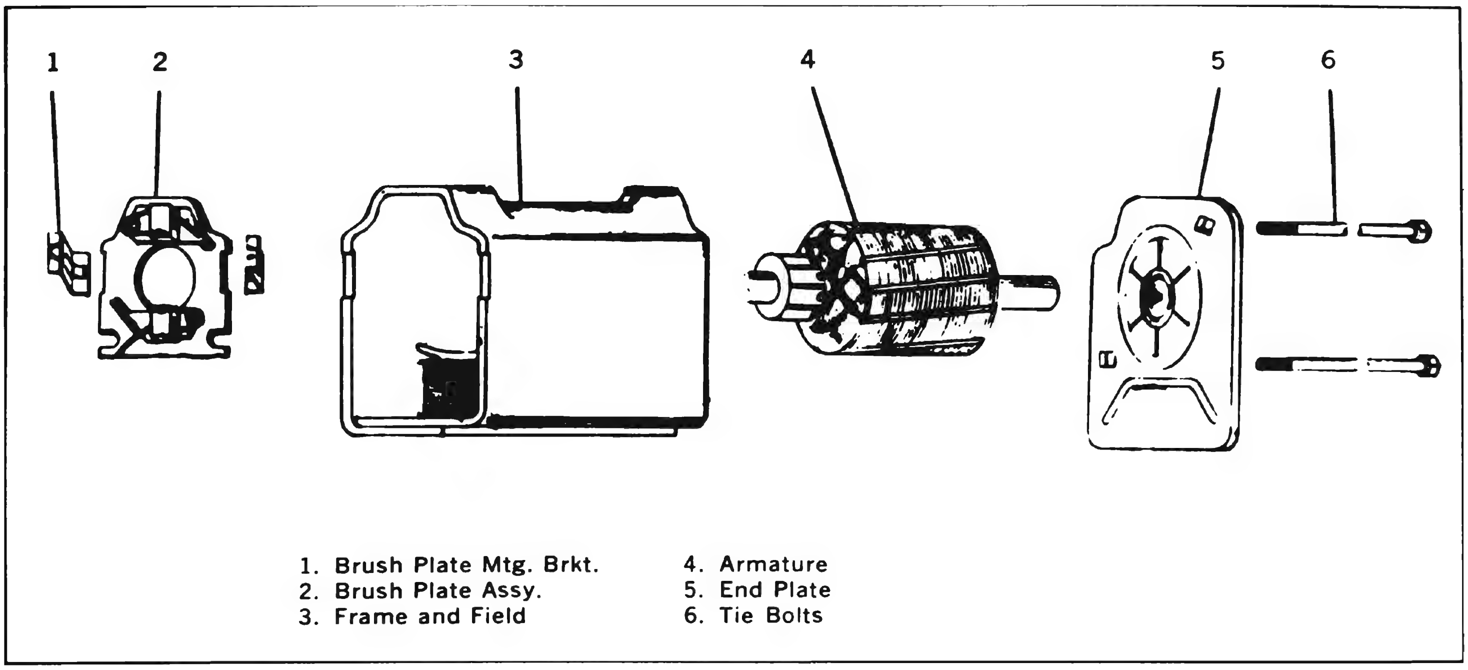


Figure 10-107—Motor Assembly

4. Remove end play adjusting washers.

To reassemble motor, reverse Steps 1 thru 4.

NOTE: Lubrication of armature shafts and bearings should be with light grade machine oil. Gear teeth and cam should be lubricated with Delco gear and cam lubricant.

d. Wiper Specifications

Operating Test Voltage 12

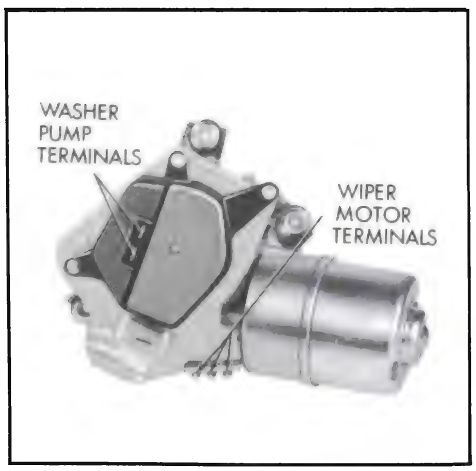


Figure 10-108—Windshield Wiper Motor-Two Speed

Crank Arm Rotation
(looking at arm) . . . . . . CCW

Current Draw (Amps.)

No load.	3 Max.
Dry windshield	3.5 Max.
Stall	11.0 Max.

10-57 DESCRIPTION AND OPERATION— TWO SPEED

a. General Description

Single speed wipers are standard on 4400 and 4600 Series with two-speed overlapping system available as an option. The two speed overlapping system is standard on 4700 and 4800 Series. Windshield washers are standard on all overlapping systems. The two speed overlap wiper motor is larger and different in design from the single speed motor and is equipped with a washer pump. See Figure 10-108. The pump is bolted to the bottom of the wiper motor assembly and is driven by the motor. The pump is relay actuated by a switch on the instrument panel.

To operate the windshield washer, the button on the switch must be pushed in or forward. In so doing, the wiper switch knob is mechanically rotated by the button to the slow speed position. After the washer has stopped, the knob must be manually turned back to the off position to stop the wiper blades. The blades always return to the depressed park position when the switch is turned to off. If a faster wiper blade speed is desired, the knob should be turned all the way in a clockwise direction.

The single speed wiper switch has no button and is only a single position switch. When the switch is turned to the off position, the blades do not return to a full park position, but a few inches away from the reveal molding. See Paragraph 10-56 for service procedures on the single speed windshield wiper.

All motors are held to the upper cowl by three bolts. A water deflector is used on the motor shaft and is located under the motor drive crank and arm assembly.

Each wiper transmission is held to the upper cowl by three screws.

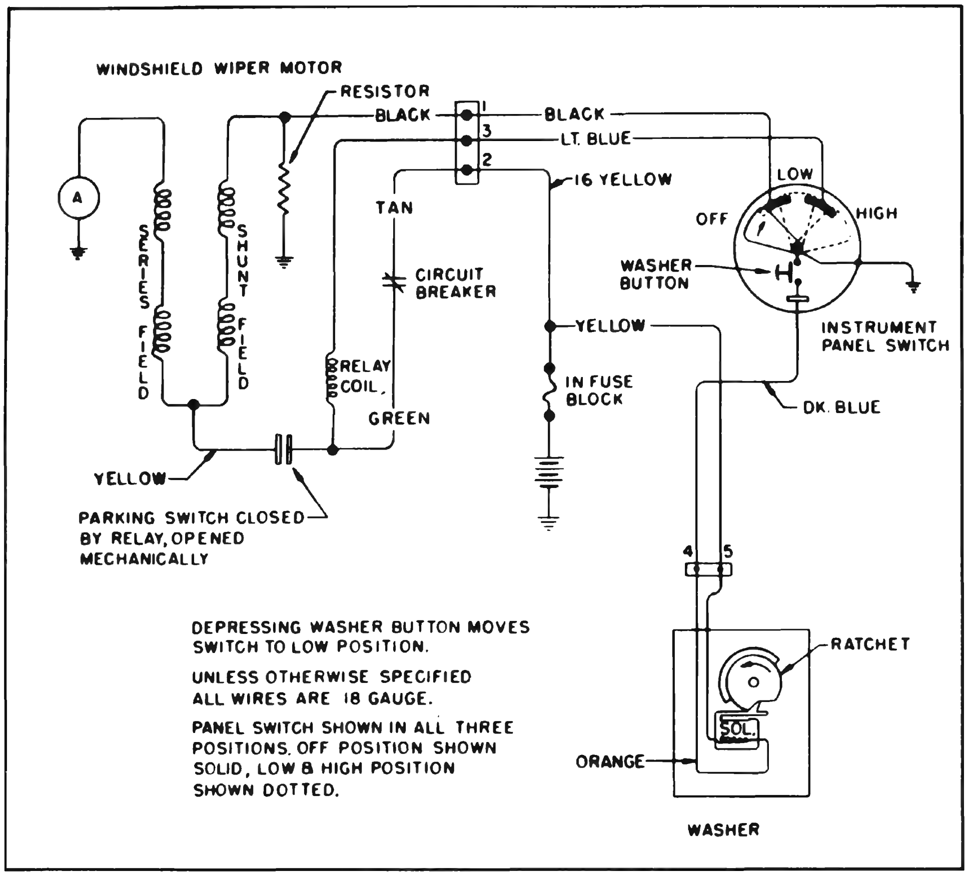


Figure 10-109—Two Speed Windshield Wiper and Washer Wiring Diagram

Although the transmission links may appear to be the same they are different, and right and left transmissions are not interchangeable.

The tubular drive links which are located under the air intake grille attach to the drive crank arm on the motor shaft on one end with the opposite end attached to the pin plate assembly on the transmission. The linkage used with the "Overlap System" is different from that used on the single speed wipers and cannot be interchanged.

CAUTION: It is important that when the wiper arms of "Overlap System" are in the park position, the right arm must be positioned below the left arm. If the arms should be reversed the system will not operate because the left blade will lock into the right blade assembly. The reason for this is that the left wiper transmission has a mechanical advantage such that the speed of the wiper blade on the left arm is faster causing it to move away from the park position more rapidly. Should the blades become bound up for reasons mentioned above, the wiper should be turned off immediately. The blades can be freed only by removing the wiper arms from the wiper transmission or bending the blades to free them.

b. Wiper Motor Operation

1. Electrical (See Figure 10-109 for overall wiring diagram.)

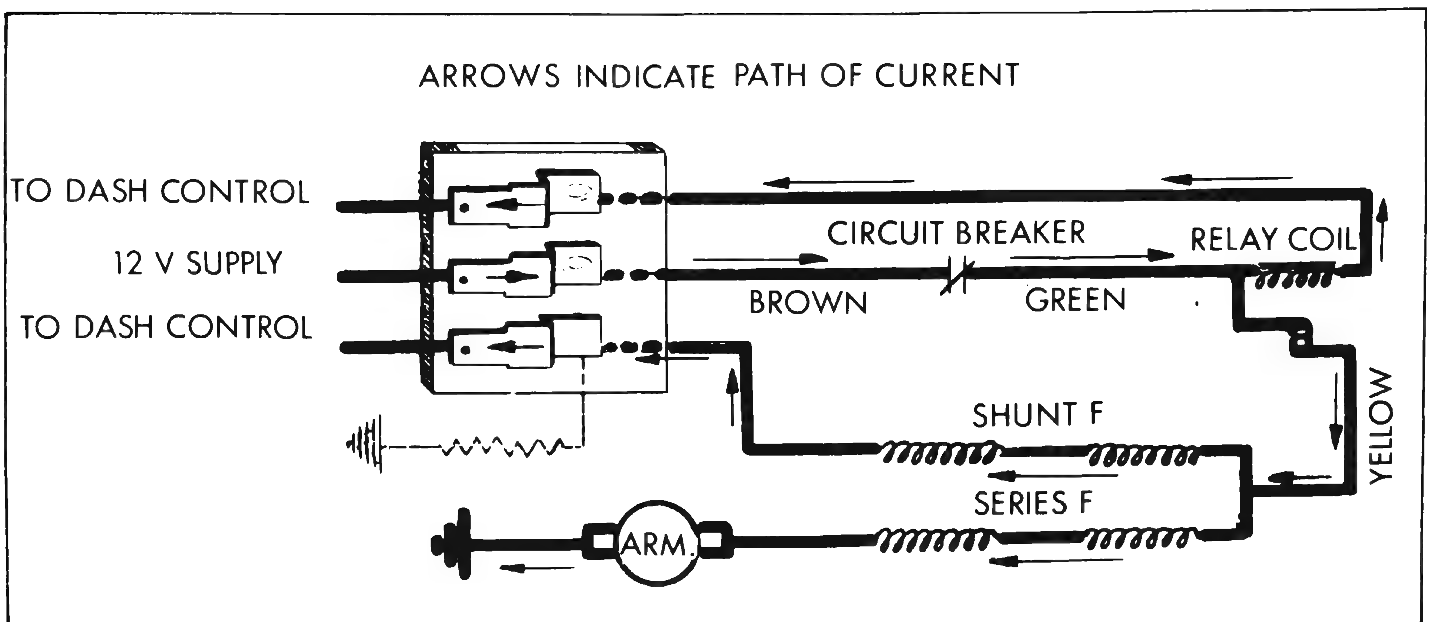


Figure 10-110—"Lo" Speed Operation-Wiring Circuit

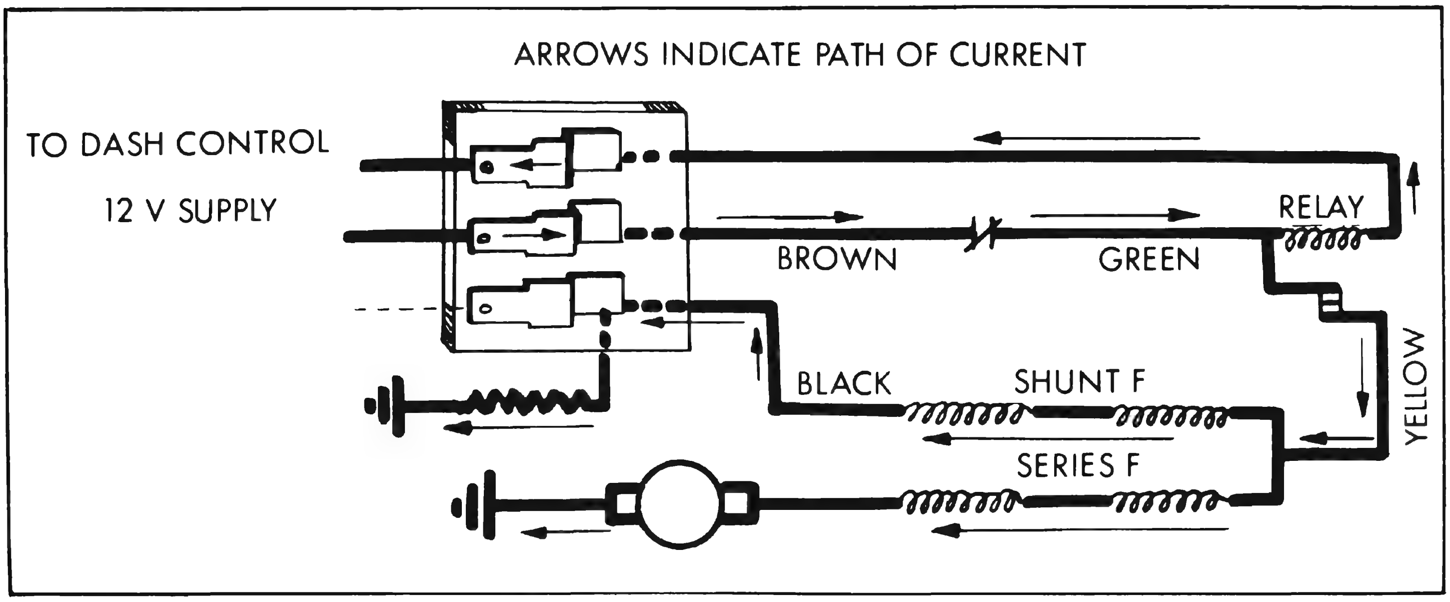


Figure 10-111—"Hi" Speed Operation—Wiring Circuit

(a) "Lo" Speed - When the switch is turned to the "Lo" position current passes from the live feed through the circuit breaker, which is located inside the motor case to the green lead. See Figure 10-110. Current then flows through the relay coil, to the white lead on the terminal connector and to ground through the dash switch to complete the relay circuit. The relay coil is then energized.

As current flows to the relay coil, it also passes through the yellow wire to a split tee type connection. Current divides with some current passing through the black lead to the terminal connector and to ground at the dash switch to ground out the motor shunt field circuit. The remaining current passes through the motor series field circuit, to the motor armature and to ground. The current flow through the switch to ground is greater than the amount through the armature. Therefore, the motor operates at a reduced speed.

(b) "Hi" Speed - When the switch is turned to "Hi" position, the motor shunt field circuit is no longer grounded due to the switch position. See Figure 10-111. The majority of current then passes through the motor series field circuit, to motor armature and to ground. Some current does pass through the shunt field windings and to ground through a resistor located between the terminal board #3 terminal and ground. However, less resistance is offered to current flow through the series field circuit. Therefore, the greater flow of current through the armature increases wiper motor speed.

(c) "Hi" or "Lo" to Off - When the dash switch is turned to the off position, only the relay coil circuit is opened, stopping current flow through the relay. The motor circuit remains in operation until the relay switch control tab is mechanically opened by the drive pawl as the pawl contacts the stop arm. The relay switch control then opens the motor circuit and the motor stops with the wiper blades positioned in park. The wiper should move to the park poisition at "Lo" speed.

2. Mechanical

(a) Motor Switch Turned to "Lo" or "Hi" - Previous to the switch being turned to either "Lo" or "Hi", the drive pawl is in contact with the stop arm. See Figure 10-112. As the switch is turned on, the relay coil is energized. This moves the armature into the relay and the latch arm out of the path of the drive pawl. At the same time, the motor circuit is also completed.

As the motor begins rotating, only the nylon gear and eccentric shaft start to turn. The drive plate is prevented from turning by the drive pawl which is held against the stop pawl. When the nylon gear and shaft have turned approximately 180 degrees, guide pins on the drive pawl and lock pawl drop into their respective pockets in the nylon gear. This action moves the drive pawl away from the stop arm as well as locking the entire drive assembly together. The drive plate, drive pawl, lock pawl, nylon gear and eccentric shaft then turn as a unit. See Figure 10-113.

(b) Motor Switch Turned to Off - As the switch is turned to the off position, the relay circuit is opened with the motor circuit remaining closed. The spring loaded latch arm moves out into the path of the drive pawl since the relay

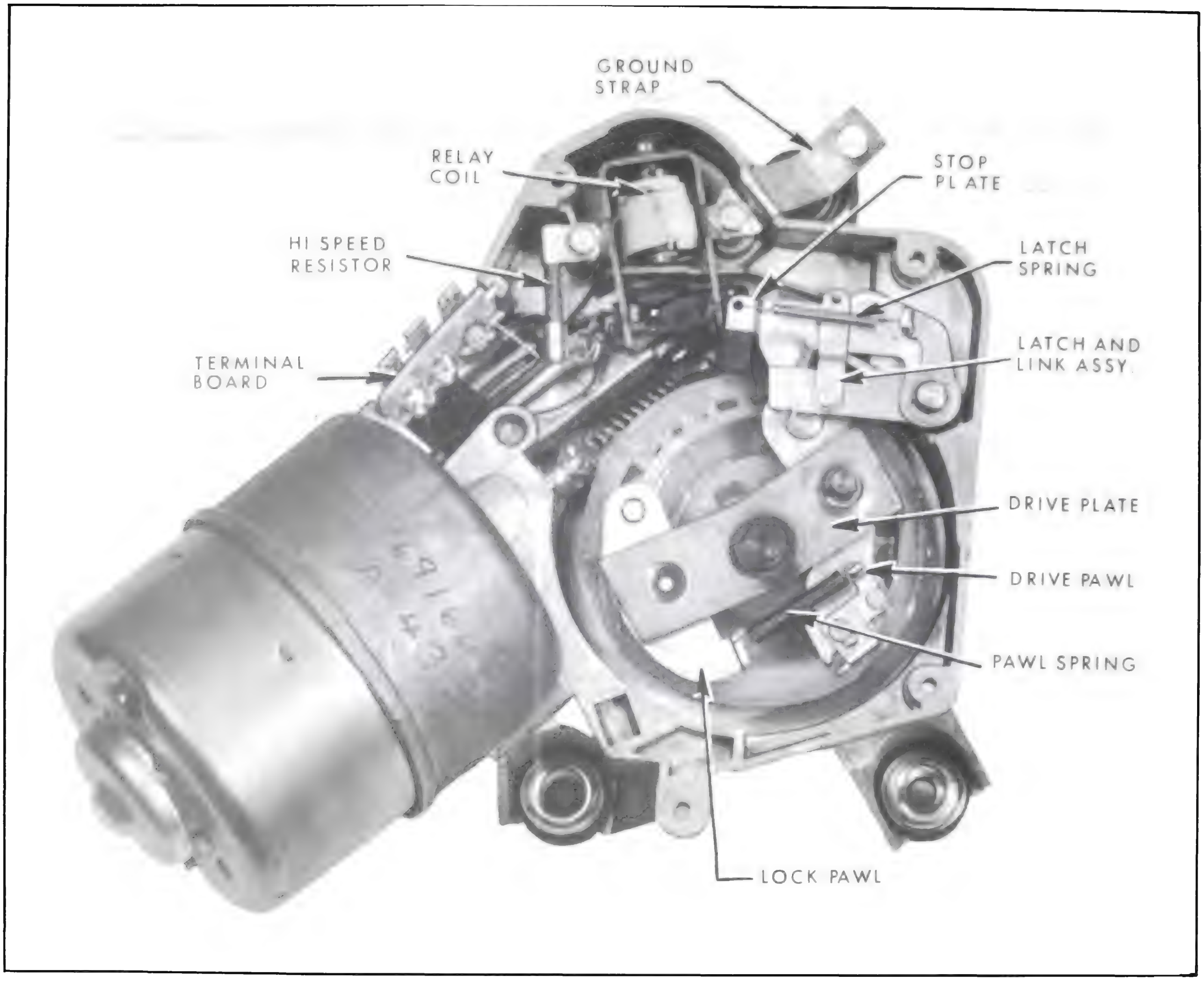


Figure 10-112—Wiper Motor in Off Position-Typical View

is no longer energized. When the drive pawl contacts the latch arm, the drive plate, drive pawl and lock pawl are held from rotating with the nylon gear and eccentric shaft continuing to rotate. See Figure 10-114. The guide pins in the drive pawl and lock pawl have been forced out of their pockets in the nylon gear.

The cam type action between the eccentric shaft and drive plate shaft makes the drive plate and related parts move outward toward the relay control switch as the nylon gear and shaft turn. The drive pawl then pushes against the relay control switch tab and opens the circuit to the motor. See Figure 10-112.

10-58 TROUBLE-SHOOTING AND TESTING

Testing is divided into two testing sections. The first section is testing to be done with the wiper motor in the car. The second section covers testing with motor out of the car. See the diagnosis chart, Figure 10-115.

a. Wiper in Car

Testing with motor installed consists of checking the wiring, switch and wiper linkage.

1. Wiring

(a) Make sure wiring is properly connected to the wiper unit and switch.

(b) Check that wiper unit ground strap is securely connected to body.

(c) With ignition switch turned on, check for 12 Volts at center or No. 2 terminal of wiper unit terminal board. See Figure 10-116. Check also for 12 Volts at the brown lead terminal which connects to washer pump.

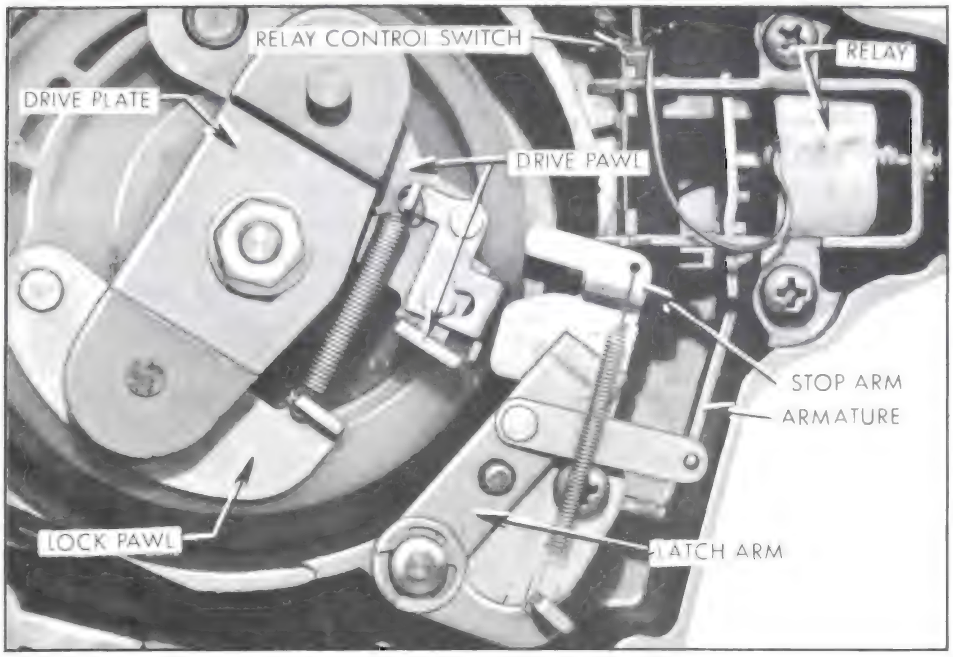


Figure 10-113—Wiper Motor in Operation-Typical View

2. Switch

(a) Check switch mounting. Loose mounting can cause an intermittent operation condition when using the wiper.

(b) To determine if switch or wiper is defective try operating wiper independently of switch as follows:

Connect 12 Volt supply to center or No. 2 terminal of wiper terminal board and connect a jumper wire from terminal No. 1 to ground. Wiper should operate in "Hi" speed.

To check "Lo" speed operation connect an additional jumper wire from terminal No. 3 to ground.

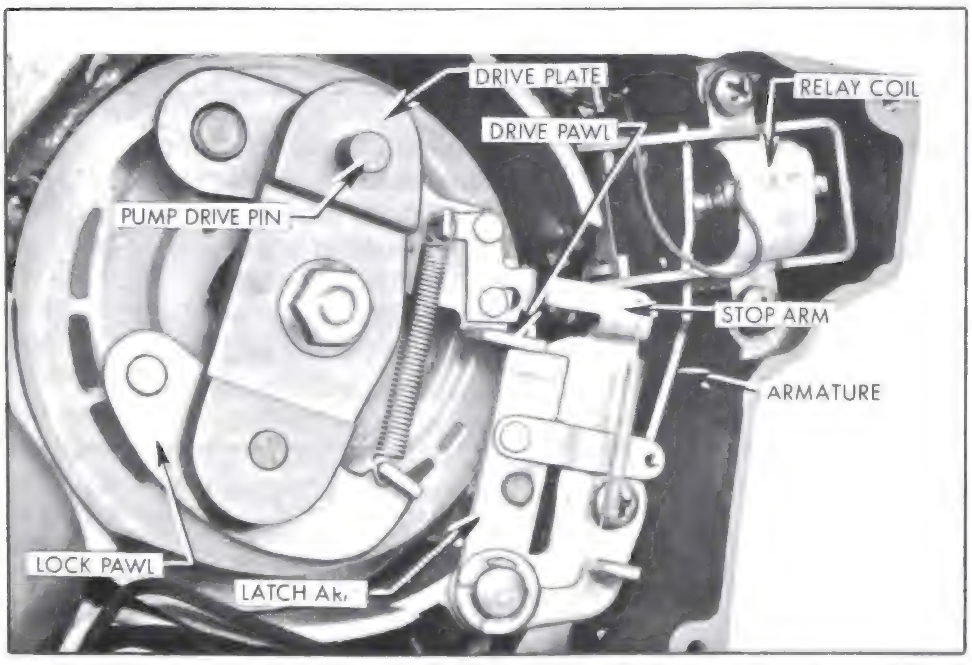


Figure 10-114—Drive Plate Stopped-Motor Running-Typical View

(c) To determine if washer pump unit or the washer button switch is defective operate washer pump independently of washer switch as follows:

Operate wiper unit as explained in Step (b) above and connect 12 Volts to either of the washer pump terminals. Connect a jumper wire from the other terminal to ground.

3. Wiper Linkage

(a) Remove necessary body parts to gain access to wiper unit crank arm and drive links. Disconnect drive links from the crank arm and manually operate each wiper transmission. The test should determine if transmissions or linkages are binding or damaged.

b. Wiper Out of Car

Testing with the motor removed consists of bench testing the relay control-latch mechanism and the motor. Remove gear box and washer pump. Disconnect the yellow lead from the relay control switch.

1. Relay Control and Latch Mechanism.

(a) Manually operate the relay armature to check for a binding or hanging-up in the latch arm and attaching parts.

(b) Circuit to Relay Coil -Connect 12 Volt supply to wiper as follows: (+) to center or No. 2 terminal and (-) to housing. See Figure 10-116. Check for 12 Volts at switch terminal to which the green lead is attached. No voltage indicates an open circuit breaker or a broken brown or green lead.

(c) Relay Coil - If circuit to relay coil checks out, leave 12 Volt supply connected as explained in Step (b) above and connect a jumper wire from terminal No. 1 to housing. Failure of relay armature to pull in indicates a weak or open relay coil. (Recheck for

DIAGNOSIS CHART PH2872

Condition	Possible Cause	Remedy
Wiper Inoperative	1. No power supply (12V) at wiper. 2. Wiper ground strap loose or disconnected. 3. Defective dash switch. 4. Wiper unit latching mechanism binding. 5. Defective relay control. 6. Defective wiper motor.	1 Check circuit from power source to wiper. 2. Connect ground strap securely to body. 3. See dash switch checking procedure. 4. See wiper latching mechanism checking procedure. 5. See relay control checking procedure. 6. See wiper motor checking procedure.
Wiper Will Not Shut Off	1. Wiper unit latching mechanism binding. 2. Relay control switch defective.	1. Free up latching mechanism and lubricate as required. 2. See relay control checking procedure.
Excessive Speed in "Hi" speed range but operates normal in "Lo" speed.	Resistor on wiper terminal board open.	Replace terminal board assembly.
Wiper operates in "Lo" speed only.	1. Defective dash switch. 2. Black lead between dash switch and wiper terminal board grounded. 3. Wiper motor black lead internally grounded.	1. See dash switch checking procedure. 2 Check body wiring to locate grounded condition and repair as required. 3. Disassemble wiper as required to locate and repair grounded condition.
Wiper operates in "Hi" speed only.	1. Dash switch defective. 2. Black lead between dash switch and wiper unit open.	1. See dash switch checking procedure. 2. Repair black lead as required.

Figure 10-115—Wiper Motor Trouble Diagnosis Chart

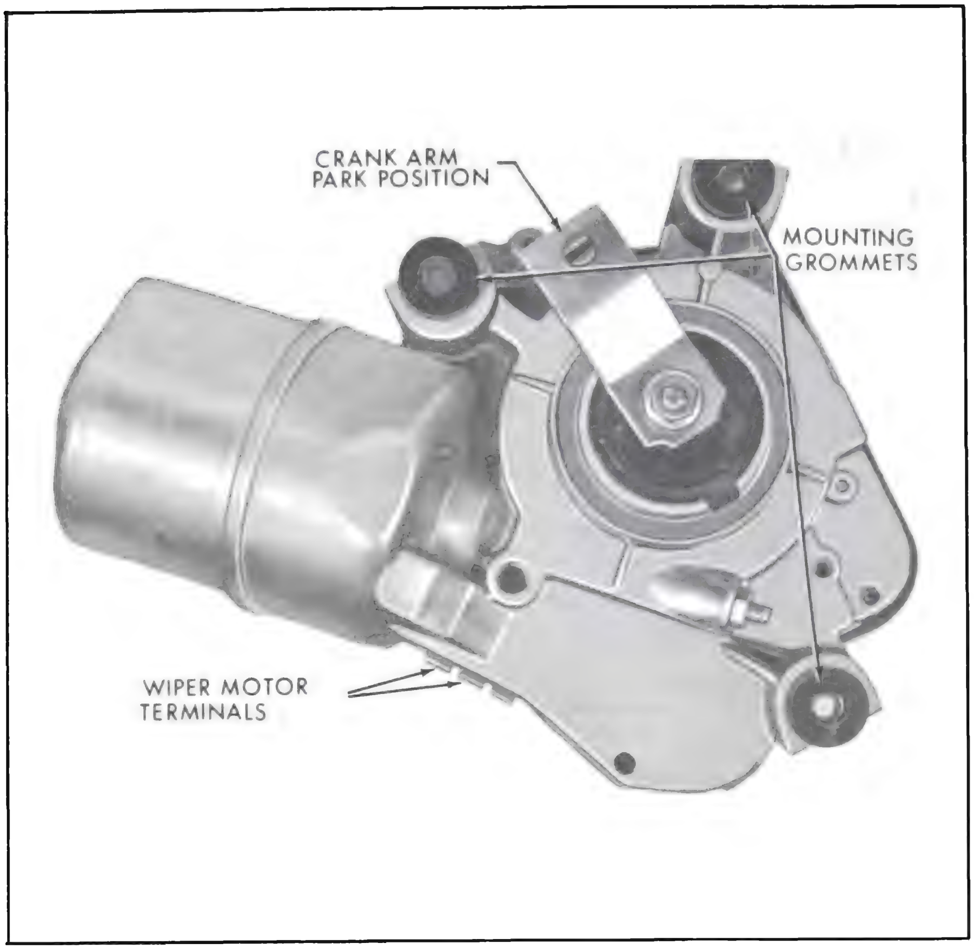


Figure 10-116—Wiper Motor Connections

a binding condition in the latching mechanism.)

(d) Relay Switch - If Steps (b) and (c) above check out correctly proceed as follows:

(1) Leave battery and jumper wire connected as described in Steps (b) and (c) and check for 12 Volts at switch terminal to which the yellow lead attaches. If relay pulls in properly and no voltage reading is obtained a defective relay switch is indicated.

(2) Disconnect jumper wire between terminal No. 1 to ground and check that relay armature moves away from coil pole. (NOTE: If wiper gear mechanism is in full park position, disconnect the coil spring that connects between the gear assembly drive and lock pawls to release the pressure of the drive pawl switch actuator against the switch tab.) Check for 12 Volts at switch terminal to which yellow lead attaches. No voltage reading indicates a defective relay switch.

(3) Leave voltmeter connected as described in Step No. 2 above and manually push the switch stop tab toward the relay coil. If voltage reading is still obtained a defective switch is indicated.

2. Motor Testing.

Disassemble the motor but leave the field coil assembly in the housing.

(a) Check armature for open or short circuit with the use of a growler.

(b) Use a growler test light to test for grounded commutator bars.

(c) Inspect the case and brush assembly for worn or defective brushes and brush springs, loose solder connections and dirty or defective circuit breaker contacts.

(d) Disconnect yellow lead from relay control switch and connect and ohmmeter between the yellow lead and the brush holder to which the internal field lead connects. No reading indicates an open series field.

Next connect the ohmmeter between the yellow lead and the terminal to which the black motor lead attaches. No reading indicates an open shunt field.

(e) Disconnect yellow lead from relay control switch. Be sure steel case and brass ground strap are not touching the housing. Then check between the yellow lead and field lamina with a test light. If bulb lights, field is grounded.

(f) Bench test motor after assembling in the following manner. Be sure brass ground strap is connected to wiper housing.

(1) "Lo" Speed - Connect 12 volt supply to center, or No. 2 terminal, and ground housing. Connect jumper wires from No. 1 and No. 3 terminals to ground.

(2) "Hi" Speed - Disconnect jumper wire from No. 3 terminal.

(3) Stop - Disconnect jumper wires from No. 1 and No. 3 terminals.

10-59 DISASSEMBLY AND ASSEMBLY

a. Disassembly of Motor

1. Remove the two motor tie bolts. See Figure 10-117.

2. Remove the armature end-play adjusting screw.

3. Strike the steel case lightly with a mallet to partially loosen

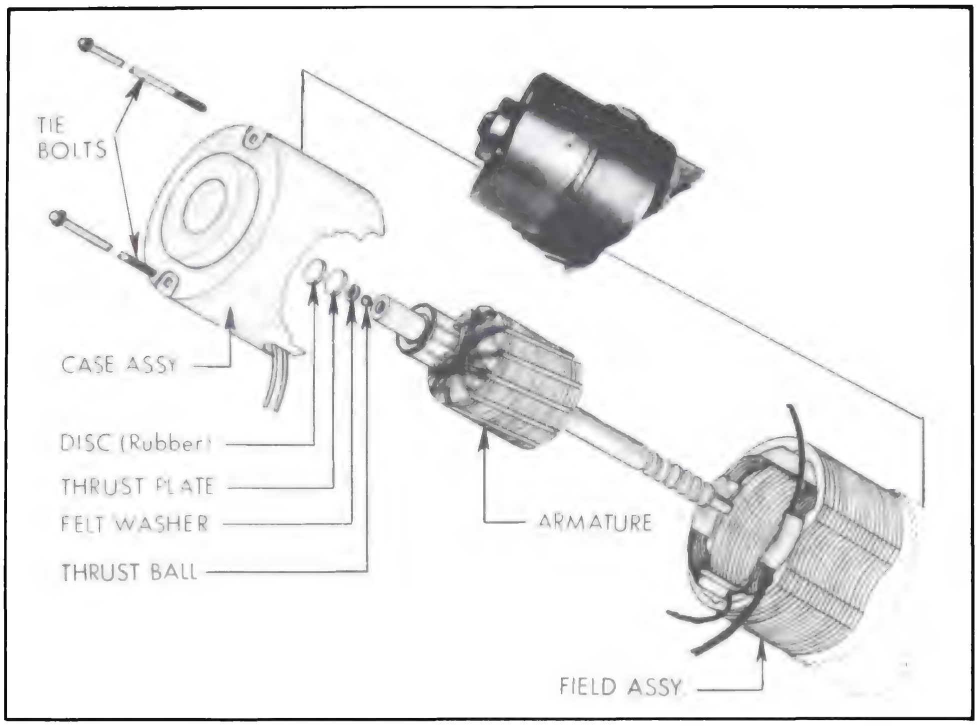


Figure 10-117—Motor Disassembly

it from the die cast housing and motor field.

4. Insert a tool through the armature adjusting screw opening and push against the end of the armature shaft to back off the case. This will retain the armature commutator in position between the brushes until ready to separate the armature from the case.

5. To separate armature from case while still retaining the brush springs and brushes in place, bend a wire as shown in Figure 10-118 and insert behind the brush leads as shown.

6. Pull the armature out of the case and install Brush Retaining Spring J-7890 as shown in Figure 10-119.

7. Remove the felt washer, thrust plate, and rubber thrust disc from the case assembly bearing as required. Refer to Figure 10-117.

8. The field assembly is pressed in the housing under light pressure and should be carefully checked prior to removal. To remove the field, proceed as follows:

(a) Cut the black and yellow leads that extend through the case assembly rubber grommet in a location convenient for splicing.

(b) Cut the internal field leads enclosed in black plastic tubing approximately two inches from the brush holder to which they are attached.

(c) Scribe a reference line along the side of the housing and field for reassembly purposes.

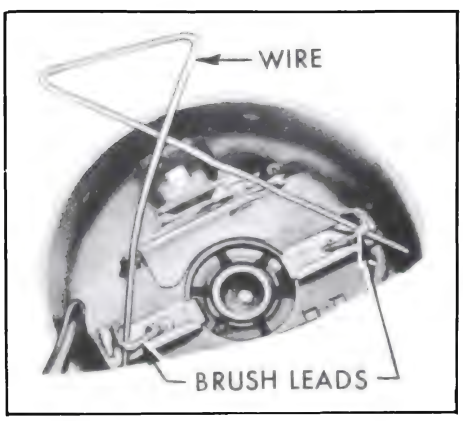


Figure 10-118—Holding Brush Leads

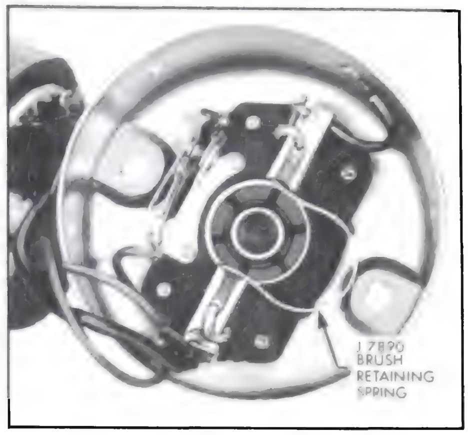


Figure 10-119—Installing Brush Retaining Spring

(d) Refer to Figure 10-120 and remove field from housing as shown.

b. Assembly of Motor

1. Install field assembly as follows:

(a) Shorten as required and splice the replacement field leads to those leads cut in Steps 8 (a) and 8 (b) under motor disassembly.

(b) Scribe a reference line on the replacement field in the approximate same location as the one scribed on the original field (Step 8 (c) under motor disassembly).

(c) Align the field and housing according to the reference lines and start the field in the housing. A further check to insure alignment is shown in Figure 10-121.

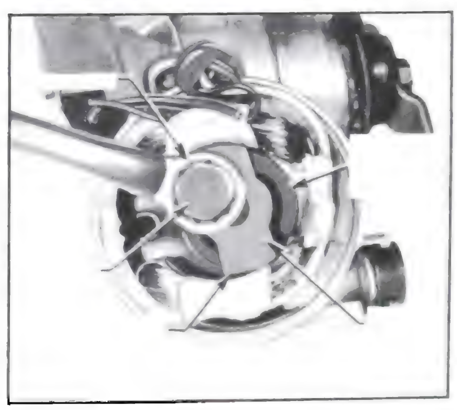


Figure 10-120—Removing Field Coils

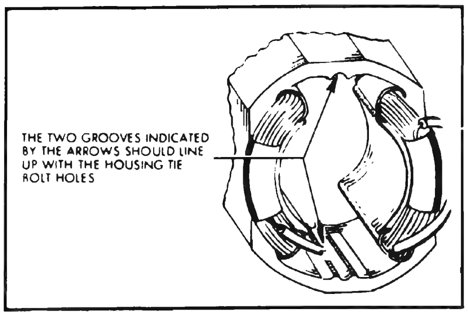


Figure 10-121—Aligning Field Coils

(d) Push the field in the housing until it bottoms aginst the machined ridge.

2. Assemble the rubber thrust disc, steel thrust plate and felt washer in the order indicated. Refer to Figure 10-117.

3. Be sure steel thrust ball is located in the commutator end of armature shaft, lubricate armature shafts and thrust ball with a high melting point grease and install armature shaft in case assembly bearing.

4. Remove the brush retainer spring.

5. Maintaining the armature in its assembled position in the case, start the armature worm shaft through the field and housing bearing until it starts to mesh with the worm gear.

NOTE: It may be necessary at this point to rotate the armature slightly before the worm will engage with the worm gear.

6. Rotate the case as required to align the holes in the case with those in the housing.

7. Being very careful not to pinch any of the motor leads between the case and edge of the field, push the case onto the field until it butts against the housing.

8. Secure the case to the housing with the two tie bolts.

9. Install end-play adjusting screw and locknut and adjust end-play as described in the adjustment section.

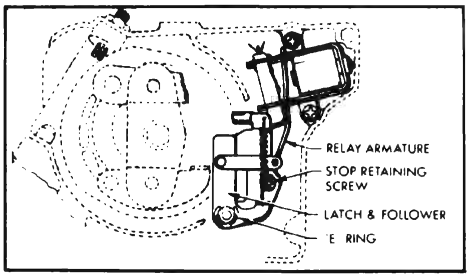


Figure 10-122—Disassembly of Relay and Latch

c. Disassembly of Relay Control and Latching Mechanism

1. Remove the four screws which secure the gear box cover or washer pump assembly to the gear box.

2. Disconnect coil spring, remove "E" ring and lift the latch and follower assembly off the pivot pin and relay armature. See Figure 10-122.

3. Remove the stop assembly retaining screw. This will permit the stop assembly to be moved as necessary to allow clearance for removing the relay control assembly.

4. Remove the two screws that secure the relay control assembly.

5. Lift the relay control assembly out of the gear box and unsolder leads as required.

d. Assembly of Relay Control and Latching Mechanism

Solder existing green and yellow wiper leads to relay control switch and solder the relay coil lead to the wiper unit terminal board as shown in Figure 10-123.

e. Disassembly of Drive Gear Mechanism

1. Remove the crank arm retaining nut. See Figure 10-124.
2. Remove crank arm and rubber seal.
3. Remove the retaining ring, end play washers, shield and spacer washer.

4. Follow Steps 1 through 3 under relay control and latch mechanism disassembly.

5. Remove gear mechanism from the gear box and slide spacer washer off the gear assembly eccentric shaft.

6. Slide the drive plate and shaft assembly out of the gear assembly, remove the lock and drive pawls and remove the coil spring.

f. Assembly of Drive Gear Mechanism

1. Assemble lock and drive pawls

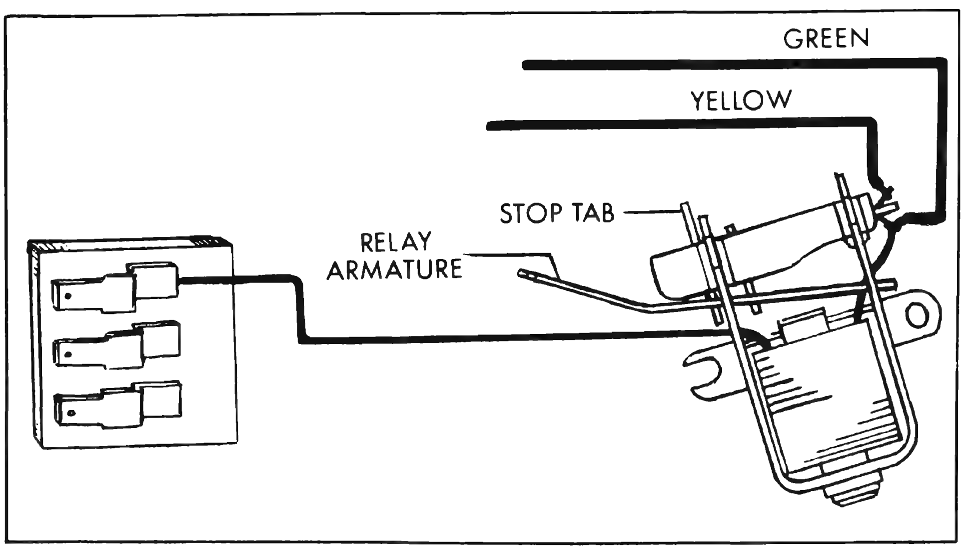


Figure 10-123—Relay Coil Wiring

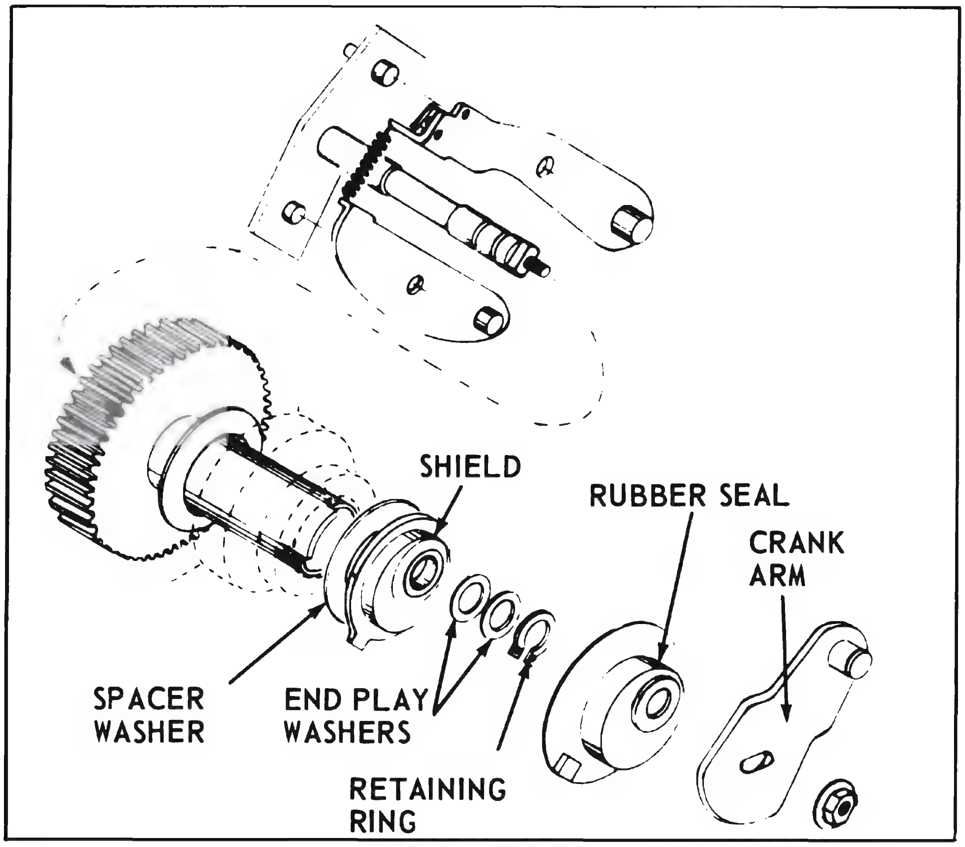


Figure 10-124—Drive Gear Mechanism

to the shaft and drive plate assembly as shown in Figure 10-125.

2. Install the assembled parts from Step 1 in the gear and eccentric shaft.

3. Connect the coil tension spring between the lock and drive pawls.

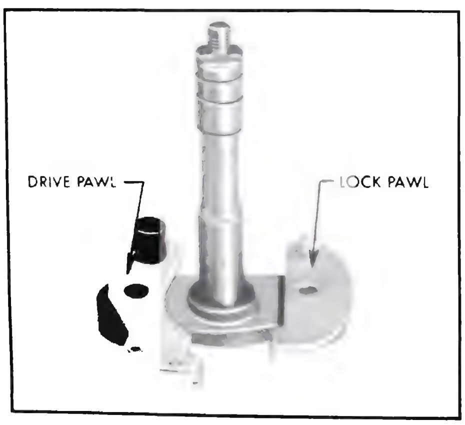


Figure 10-125—Lock and Drive Pawl Assembly

4. Reinstall spacer washer on the eccentric shaft of the gear.

5. Reinstall gear mechanism in the housing.

6. Reassemble the parts removed in Steps 1 through 4 under drive gear disassembly.

g. Adjusting Armature End-Play

1. Loosen adjusting screw locknut and tighten the adjusting screw until finger tight.

2. Back off set screw 1/4 turn and tighten locknut.

h. Adjusting Gear Assembly End-Play

1. Gear assembly end-play is controlled by end-play washers located between the seal cap and shield. See Figure 10-124. End-play should be .006.

i. Wiper Specifications

Operating Test Voltage	12
Crank Arm Rotation (looking at arm)	CCW
Current Draw (Amps.)	
No Load	3 to 4.5
Wet Windshield	3.5 to 5
Blade Wipes per Minute	
Low Speed	35 to 45
High Speed	70 to 85

10-60 REMOVAL AND REPLACEMENT OF ASSEMBLIES

a. Wiper Motor Assembly

1. Removal

(a) Disconnect wire connectors from motor and pump.

(b) Pull washer hoses loose from pump.

(c) Remove left side air intake grille.

(d) Remove spring retainer clip from wiper motor shaft lever.

(e) Lift transmission drive links off motor shaft lever.

(f) Remove three wiper motor bolts.

2. Replacement

Reverse Steps (f) through (a).

b. Wiper Transmission

1. Removal

(a) Remove wiper blade and arm, shaft and escutcheon retaining escutcheon retaining nuts and escutcheon from transmission shaft.

(b) Remove air intake grille retaining screws. Slide grille out from under reveal molding.

(c) Remove spring retainer clip from wiper motor shaft. Lift drive links off motor shaft.

(d) Remove the three transmission retaining screws.

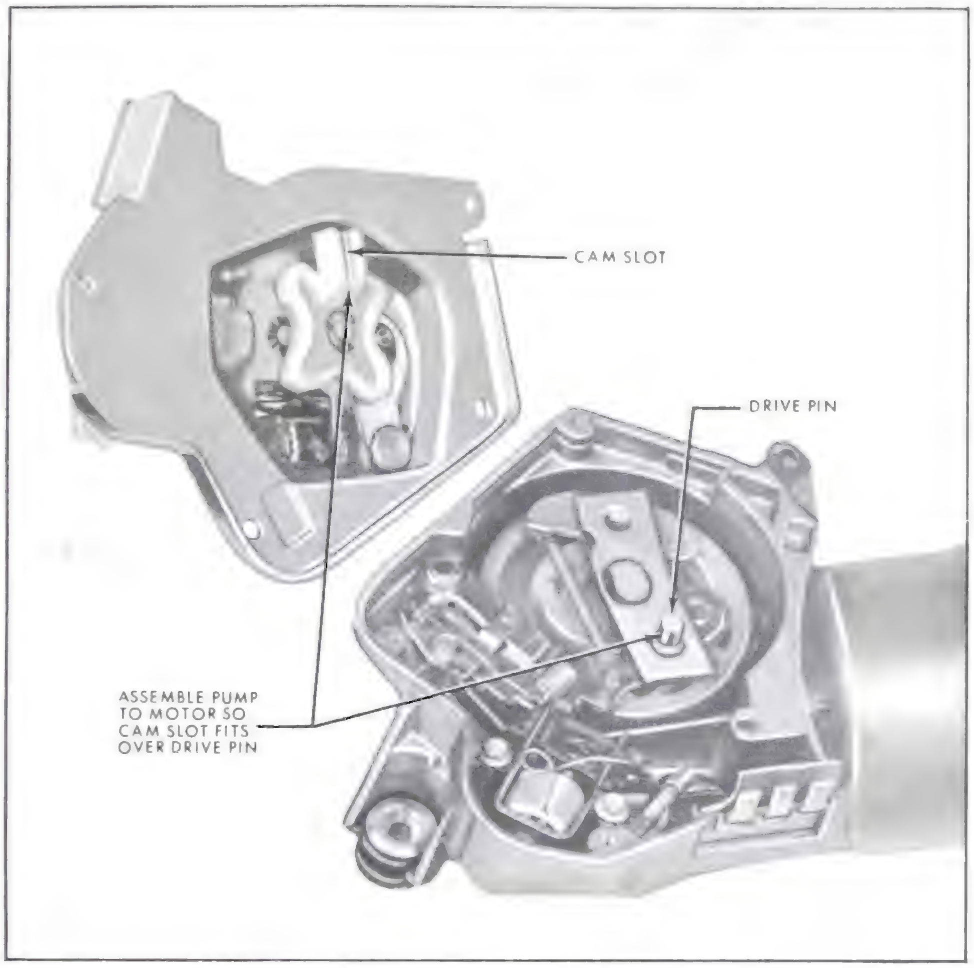


Figure 10-126—Assembling Washer Pump to Wiper

(e) Slide transmission and drive link toward opposite side of car. Lift transmission up at opening and remove.

2. Replacement

Reverse Steps (e) through (a).

10-61 WINDSHIELD WASHER DESCRIPTION AND OPERATION

a. Description

Any time that the motor is turning, a drive pin on the motor drive plate assembly turns a four lobe shaped nylon cam follower in the pump assembly. The cam follower contacts a roller on the ratchet pawl lever. See Figure 10-125 A torsion spring on the ratchet pawl lever pivot shaft makes the lever and roller follow the nylon cam follower and also puts the ratchet pawl under spring tension.

Two other shafts are located on the ratchet pawl lever, on the side opposite the roller. One of the shafts supports the ratchet pawl, while the shorter shaft actuates the pump slide lever. The pump slide lever is slotted at one end to receive the short shaft. The other end of the pump slide lever is fitted with a rubber cup type pump diaphragm and a coil spring. See Figure 10-127.

The ratchet pawl is slotted on the end opposite the pivot shaft. The slotted end contacts a nylon ratchet wheel which has 21 teeth. During pump operation, the slot in the ratchet pawl slips over one tooth on the ratchet wheel and rotates the wheel one tooth at a time until the ratchet wheel

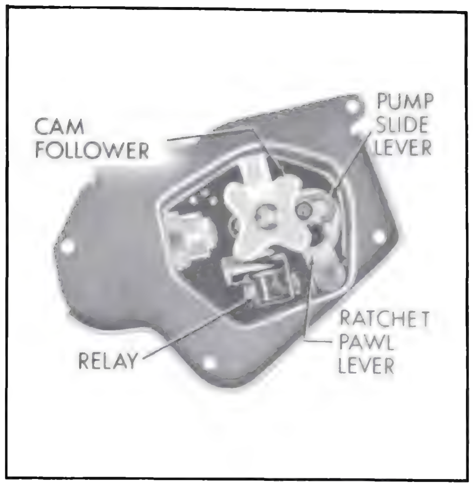


Figure 10-127—Washer Pump-Motor Side

has been rotated through all 21 teeth or one complete revolution.

The nylon ratchet wheel has a ramp on the side down toward the pump slide lever and also a notch on the top side. The ramp has two functions. First, as the ratchet wheel rotates, the ramp makes contact with a relay armature hair spring to move the spring from under the armature and allow it to drop toward the ratchet pawl. Secondly, it contacts a tang on the pump slide lever which allows the tang to climb up on the ramp and stop the pumping action.

A tang on the pump relay armature falls into the notch on the

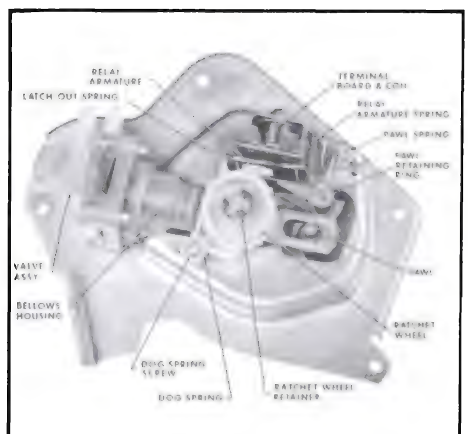


Figure 10-128—Washer Pump-Cover Side

nylon ratchet wheel when the wheel has made one revolution. This allows the ratchet pawl to slide into a wide slot in the armature, lifting the ratchet pawl away from the teeth of the nylon ratchet wheel.

A relay within the pump housing is energized anytime the washer button is depressed. See Figure 10-128. When energized, the armature is pulled up against the relay to release the ratchet pawl from the armature, allowing the ratchet pawl to engage the ratchet wheel teeth. At the same time, the relay armature hair spring trips to a position under the armature, holding it away from the ratchet wheel and ratchet pawl.

b. Operation

Pump action remains the same regardless of whether wiper motor is on when washer button is depressed or if button is depressed to start washer and motor at the same time.

1. Idling.

With wiper motor turning, the elliptical cam follower is rotated by the guide pin on the ratchet pawl lever. The tang on the pump slide lever is on the high portion of the ratchet wheel ramp, leaving the pump in a cocked position. The pump slide lever is spring loaded by a coil spring next to the rubber cup diaphragm.

With the wiper motor turning, the elliptical cam follower is rotated by the guide pin of the motor drive plate. The pump slide lever is held from pumping by the tang resting on the high portion of the nylon ratchet wheel ramp. The ratchet pawl does not engage the teeth of the ratchet wheel because it is held away from the wheel by the armature. The armature tang is engaged in the slot of the ratchet wheel. The rotating cam follower contacts the roller and moves the ratchet pawl lever back and forth. The ratchet pawl also moves, being connected to the ratchet pawl lever, but no ratchet wheel rotation takes place. The pump is idling.

2. Pumping

When the washer button is depressed, the relay energizes. The armature tang moves out of the ratchet wheel slot and the armature hair spring trips under the armature. As the armature moves toward the relay, the ratchet pawl falls free of the armature and engages a ratchet wheel tooth, rotating the wheel one tooth. The distance moved is sufficient for the pump slide lever tang to fall off the ratchet wheel ramp and allow the spring loaded pump to pump the first stroke. The pump completes one pumping stroke for each ratchet whell tooth movement. After the wheel has rotated approximately 1/2 turn the ramp engages the armature hair spring and moves it out from under the armature. The armature drops and the tang contacts the ratchet wheel but does not affect the ratchet pawl action. After another 1/8 to 1/4 turn of the ratchet wheel, the pump slide lever tang contacts the ramp with a resulting shorter pump stroke. Each succeeding stroke becomes shorter until the nylon ratchet wheel has made one complete revolution and returned to the starting position. At that point, the armature tang drops into the ratchet wheel slot, with the ratchet pawl entering the large slot in the armature and lifting away from the ratchet wheel teeth. The pump is then returned to idling and has completed one pumping cycle.

10-62 WINDSHIELD WASHER DISASSEMBLY AND ASSEMBLY

a. Removal and Replacement of Relay and Terminal Board

1. Remove washer pump cover. See Figure 10-128.

2. Rotate nylon rotor cam to free ratchet arm from relay armature and lift out relay coil assembly.

CAUTION: Whenever it is necessary to solder connection on either the wiper or the pump, rosin core solder should be used. Do not use acid core solder.

3. To reinstall, hold relay armature in against the coil pole and position the relay mounting stud in the slot provided in the pump body casting.

4. Install spring clip on relay mounting stud.

5. Assemble terminal insulator over terminals and position terminal board.

6. Manually rotate washer pump through a complete cycle to check if pump is operating properly.

b. Removal and Replacement of Valve Assembly

1. Remove four screws attaching valve to pump body.

2. Carefully remove valve assembly.

3. To install reverse removal procedure.

NOTE: Be certain that bellows is positioned properly when valve assembly is installed.

c. Removal and Replacement of Bellows

1. Remove valve assembly.

2. To release bellows unit from pump plunger, hold end of pump slide lever, push in against bottom of bellows and turn bellows approximately 1/4 turn.

3. To install, reverse removal procedure.

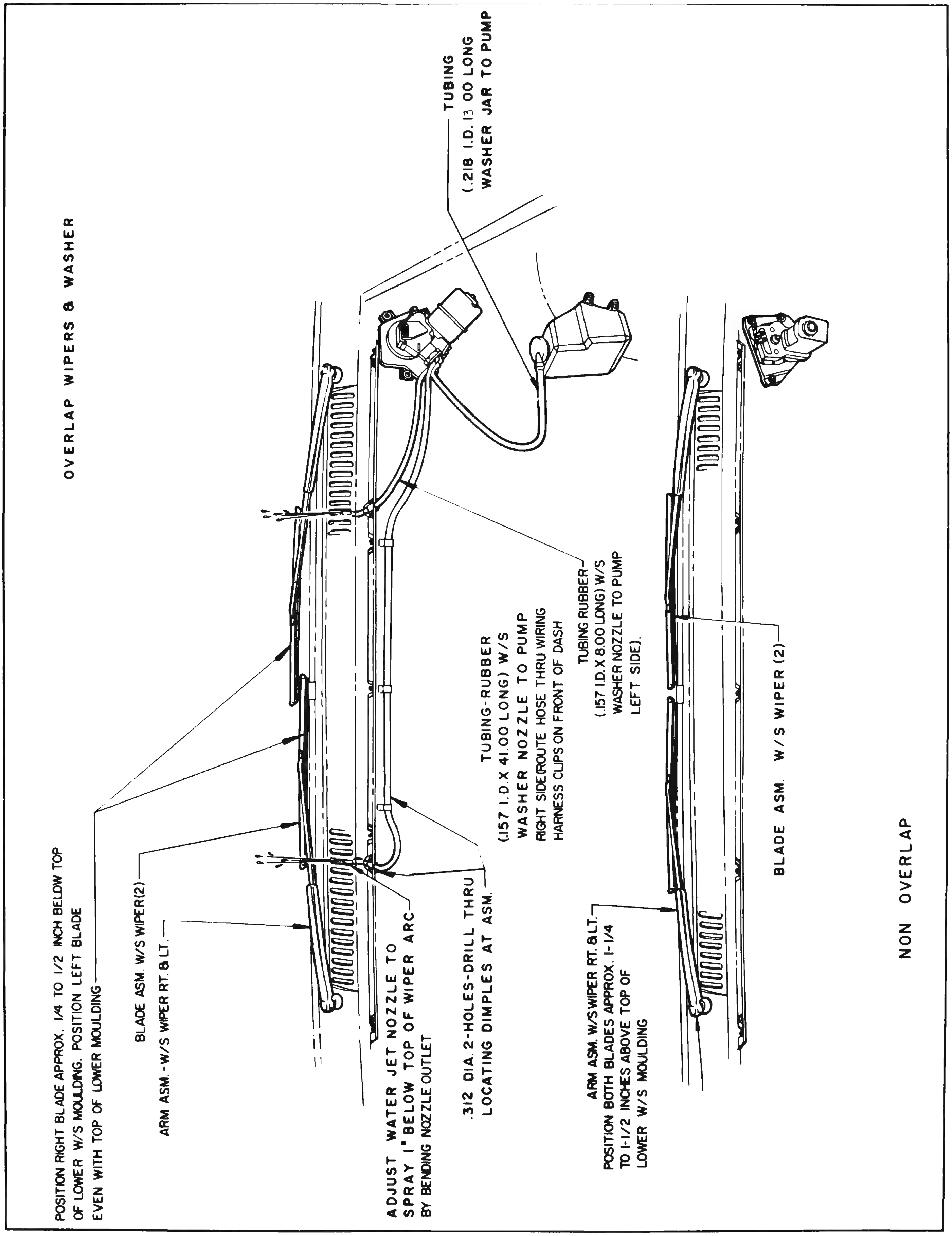


Figure 10-129—Washer Nozzle Aiming and Wiper Arm Installation

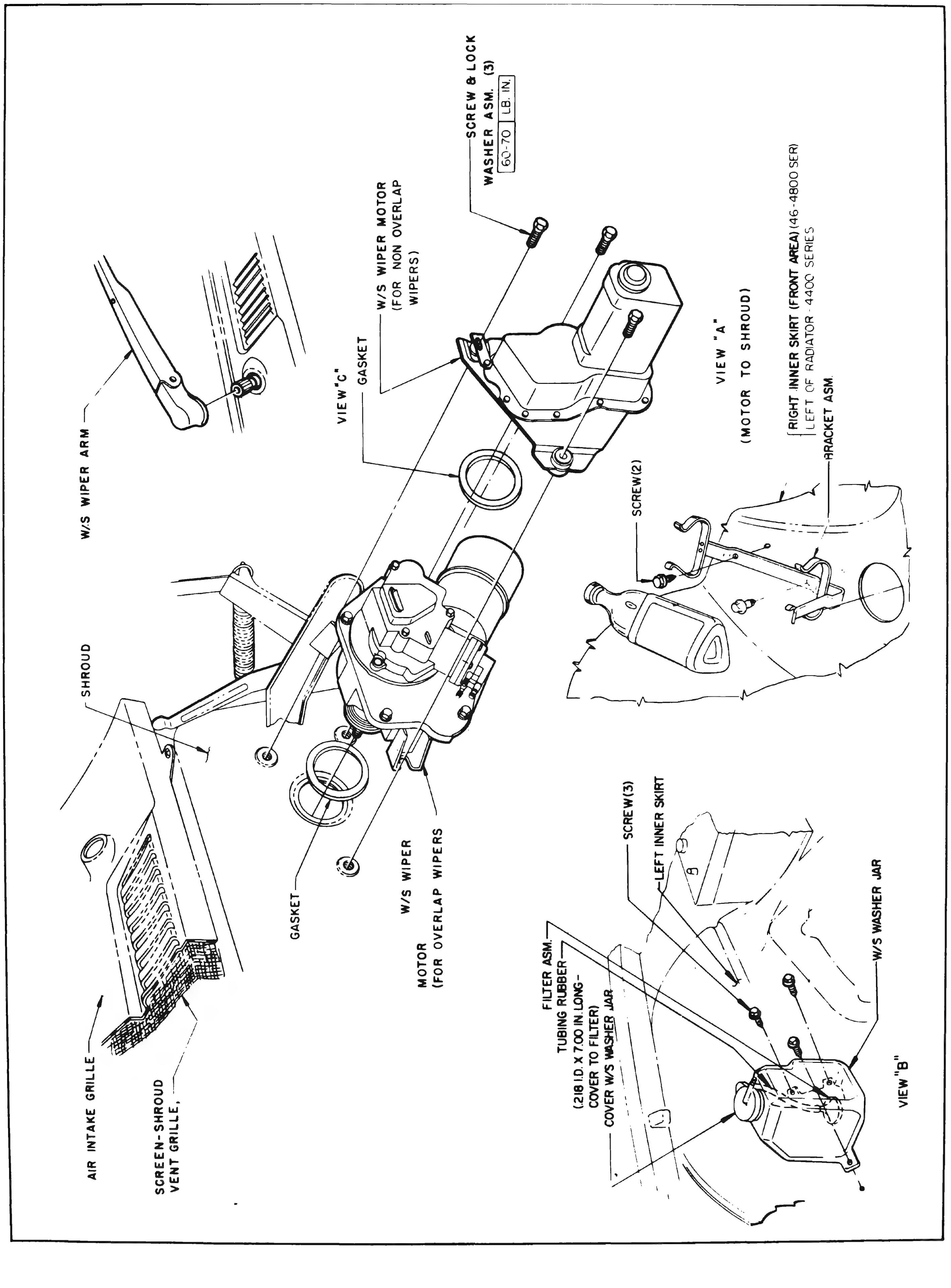


Figure 10-130—Windshield Wiper and Washer Installation

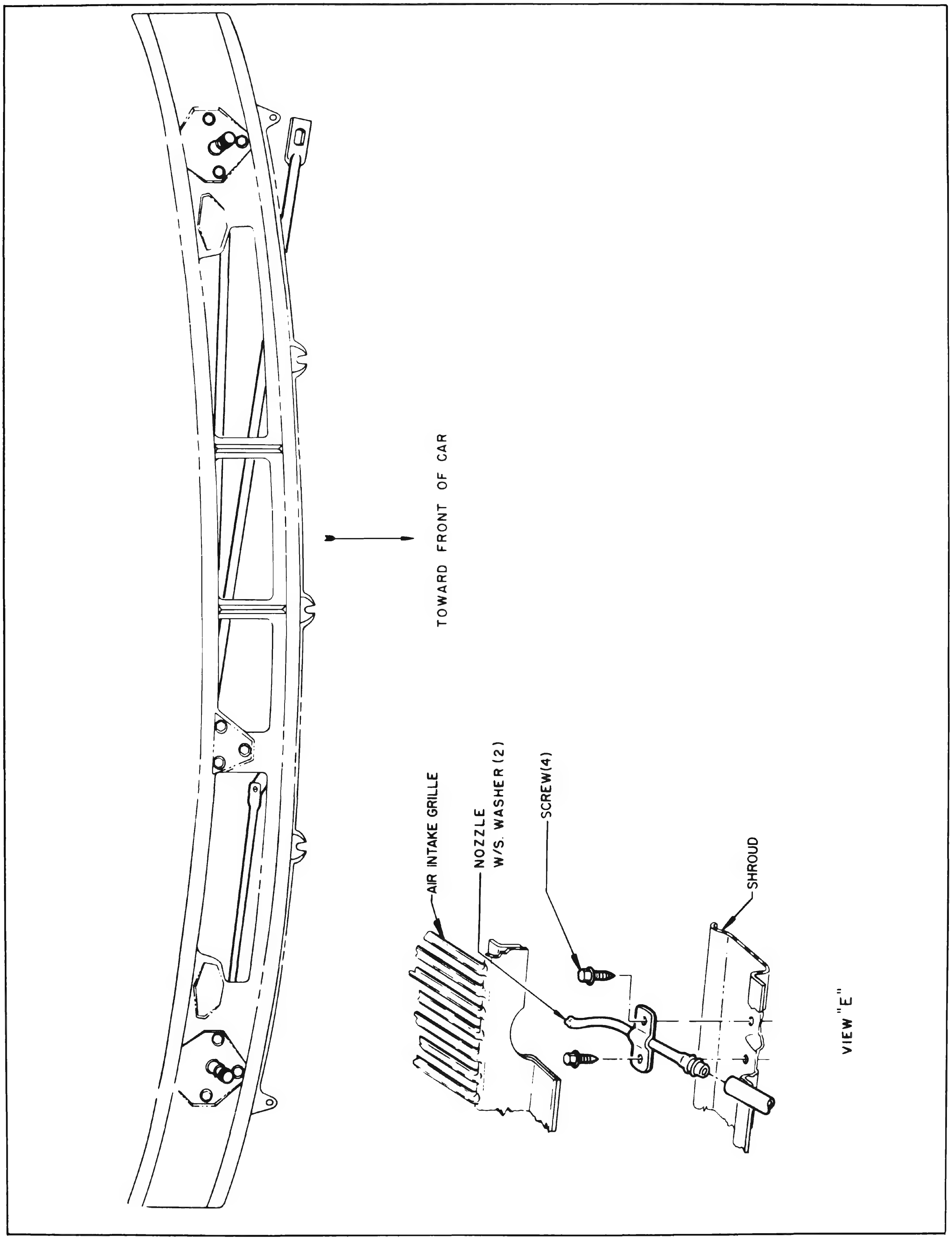


Figure 10-131—Windshield Wiper Linkage and Washer Nozzle Mounting

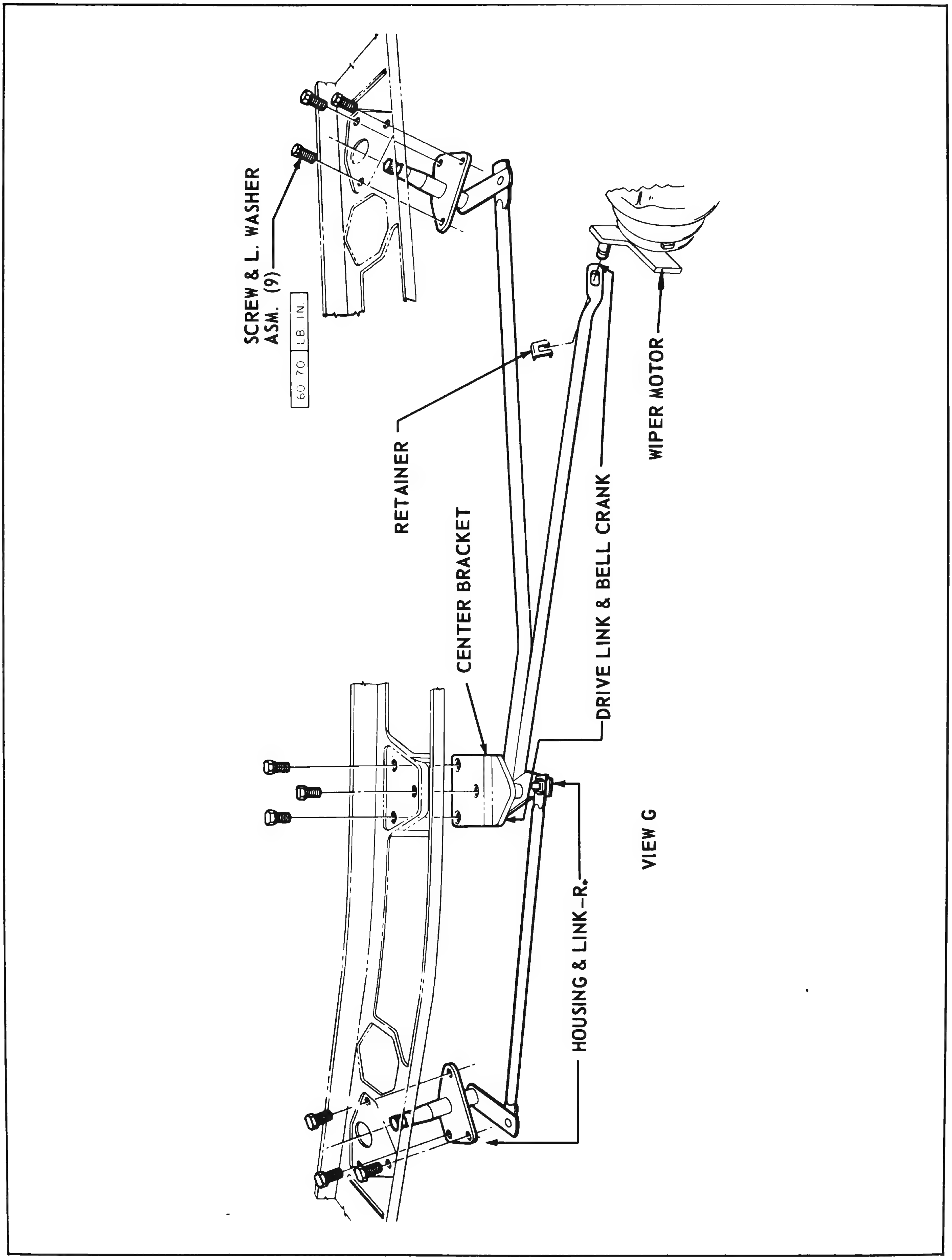


Figure 10-132—Windshield Wiper Linkage Installation

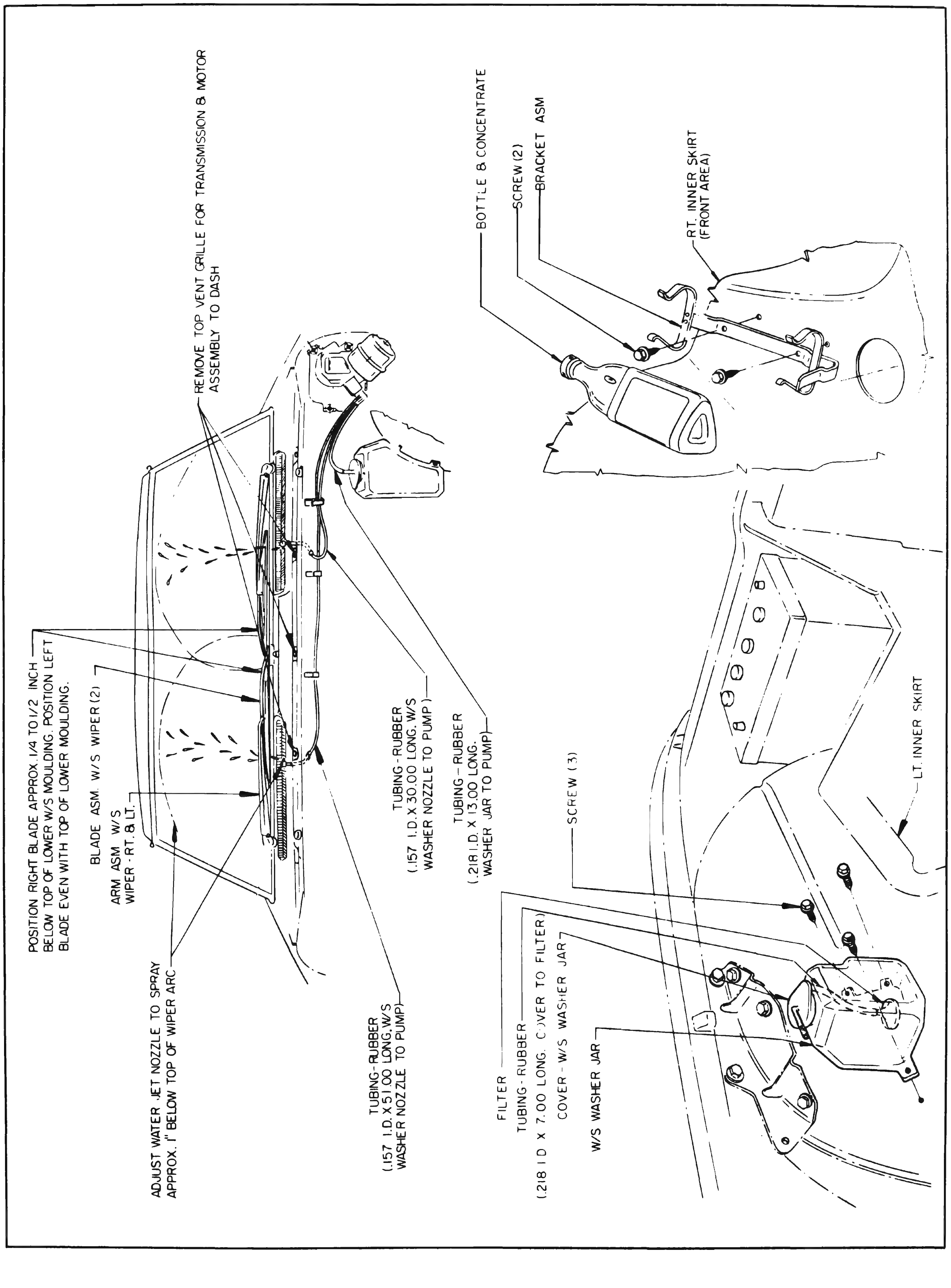


Figure 10-133—Windshield Wiper and Washer-Riviera

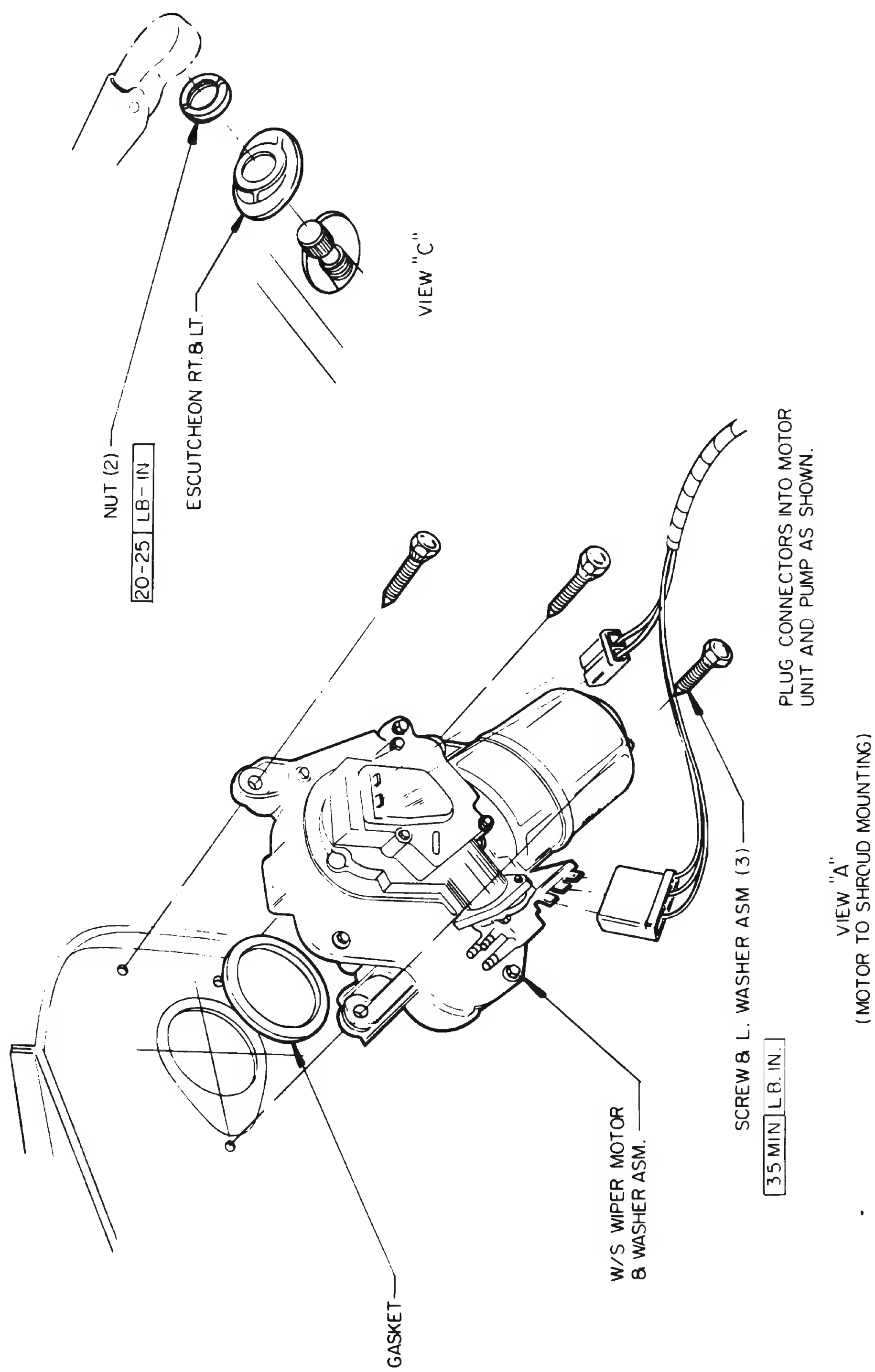


Figure 10-134—Windshield Wiper Motor Installation-Riviera

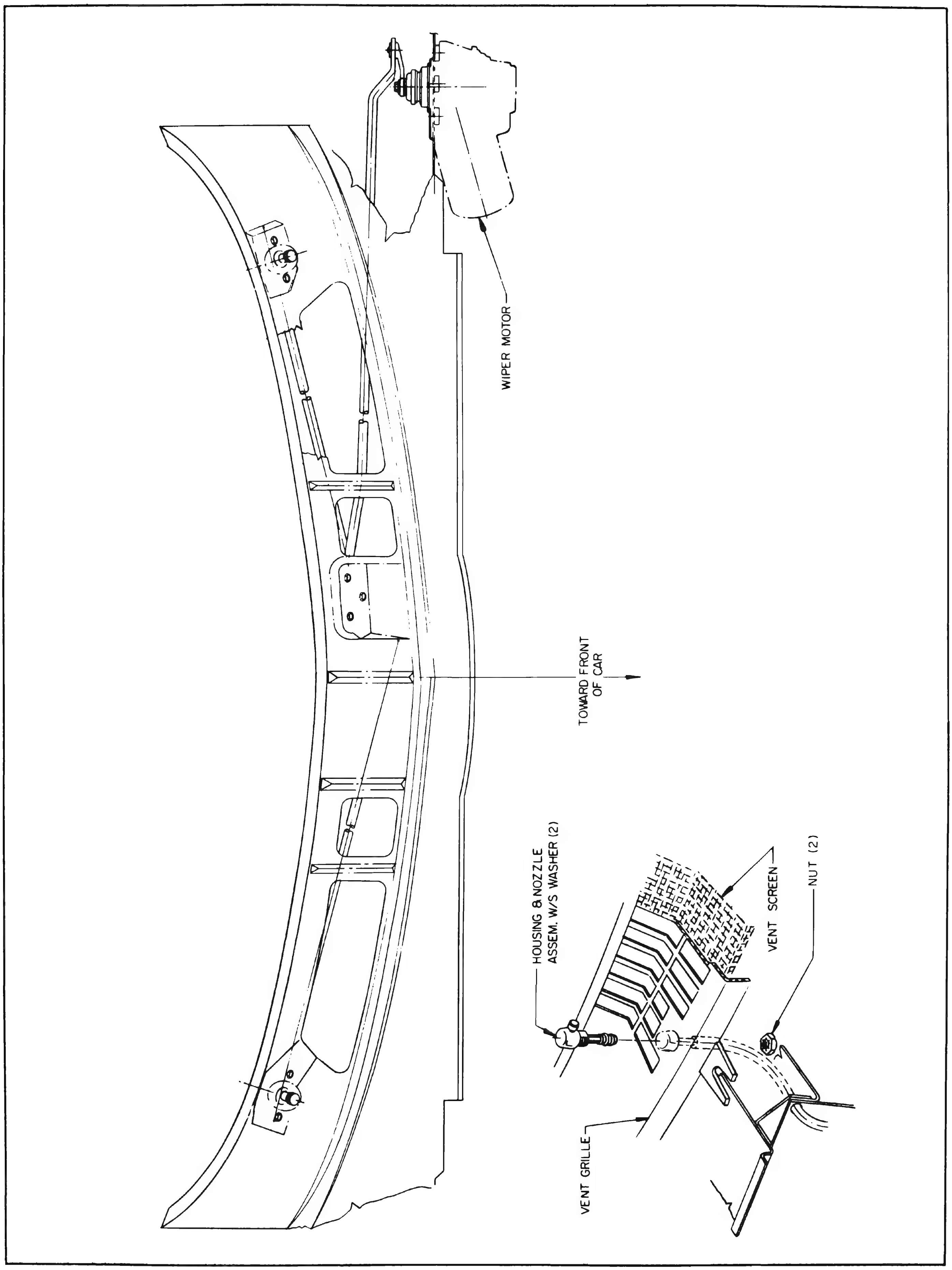


Figure 10-135—Windshield Wiper Linkage and Washer Nozzle Mounting-Riviera

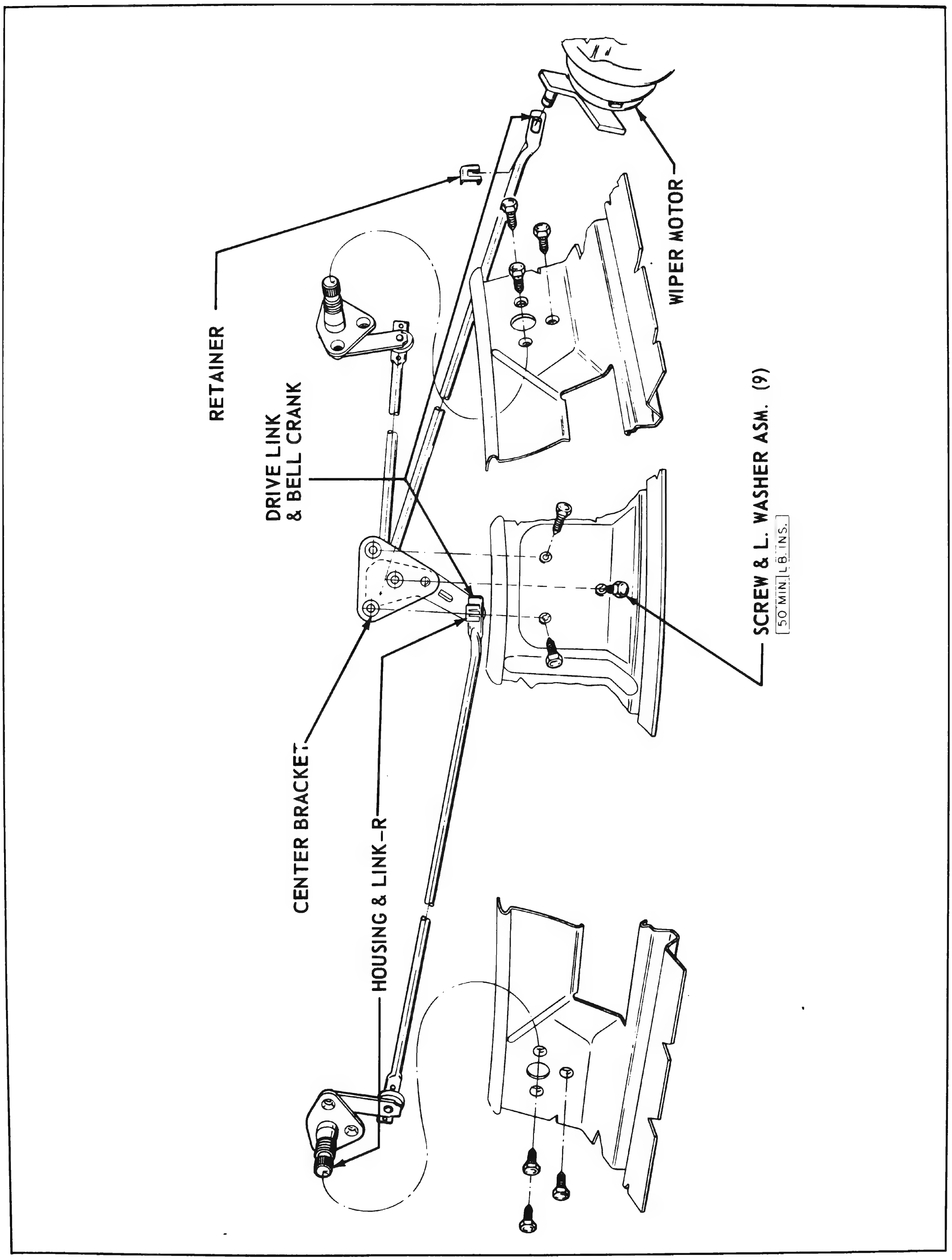


Figure 10-136—Windshield Wiper Linkage Installation-Riviera

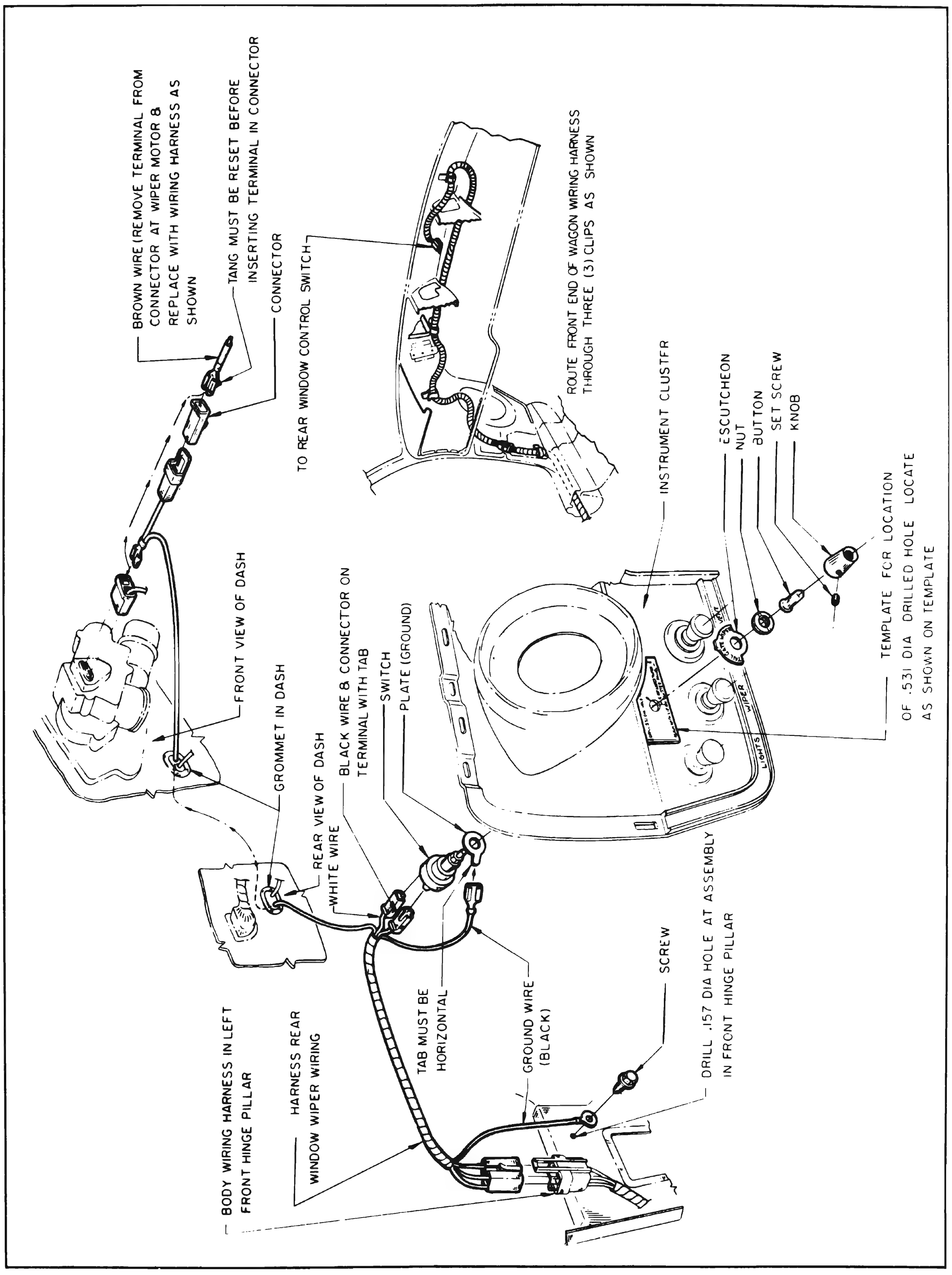


Figure 10-137—Tailgate Window Wiper Wiring

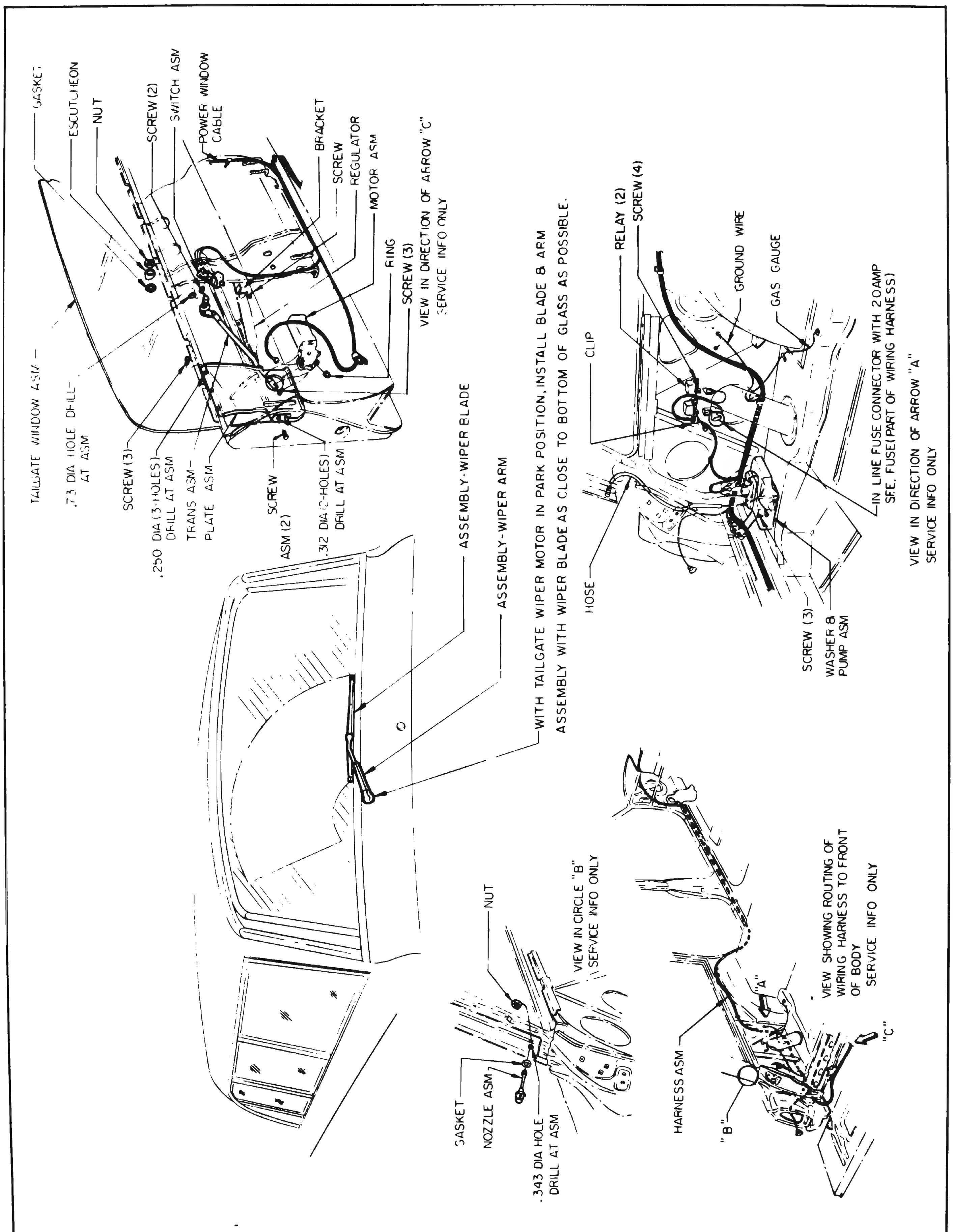


Figure 10-138—Tailgate Window Wiper and Washer

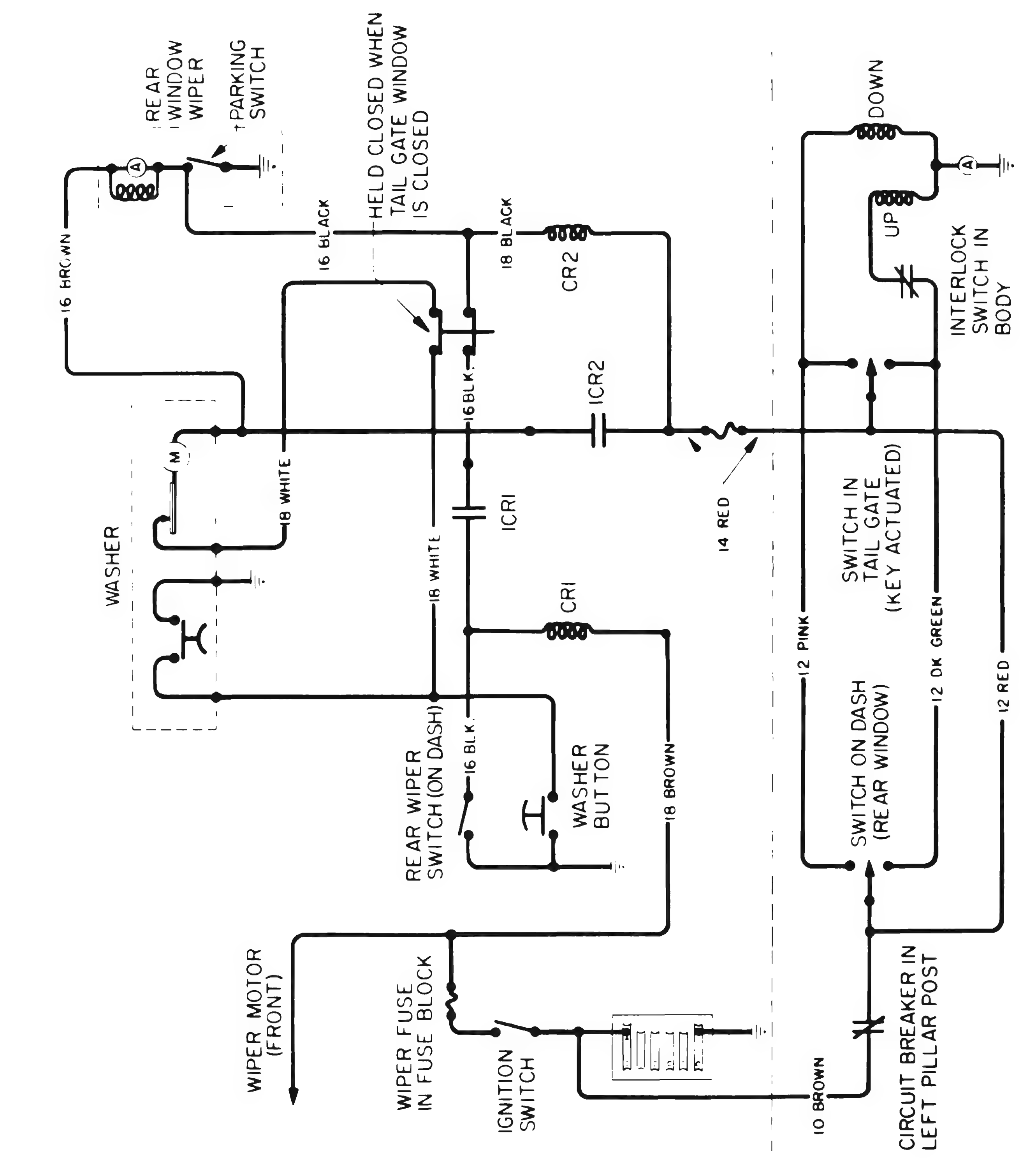


Figure 10-139—Tailgate Window Wiper Circuit Diagram

SECTION 10-J

WIRING CIRCUIT DIAGRAMS

CONTENTS OF SECTION 10-J

10-63 CIRCUIT DIAGRAMS AND FUSE BLOCK

This section contains schematic wiring circuit diagrams for complete car. For more detailed body wiring diagrams showing the routing of the wires and the location of the switches, connectors and retaining clips - see the Buick Body Service Manual. Wiring diagrams of the power window and power seat circuits are also in that section.

A few of the most important wiring terminals are connected with screws. However, most of the terminals have a flat push-pull type connector, the terminal on the wire requires a straight hard push to seat it in the socket. A hard steady pull on the terminal is required to detach if from the socket.

A central fuse block is mounted under the left side of the instrument panel. This fuse block serves as a convenient junction point for a number of circuits, provides a mounting for the direction signal flasher, and contains most of the fuses. The fuse block is held in its bracket by a spring clip and may be easily slipped out to check the fuses on one side or to check the connections on the other side. See Figure 10-144 or 160.

To simplify replacement of the wiring, the circuits to the rear of the cowl are grouped in one harness and the circuits forward of the cowl are grouped in another. The instrument panel wiring harness ends in a multiple connector which is held in the cowl. The engine compartment wiring harness plugs into this connector at the cowl. This type of connector aids in tracing down electrical troubles. See Figure 10-145 or 159.

Figure 10-140 may be used as an index for the Series 4400-4600-4800 electrical figures; Figure 10-155 may be used as an index for the Riviera electrical figures.

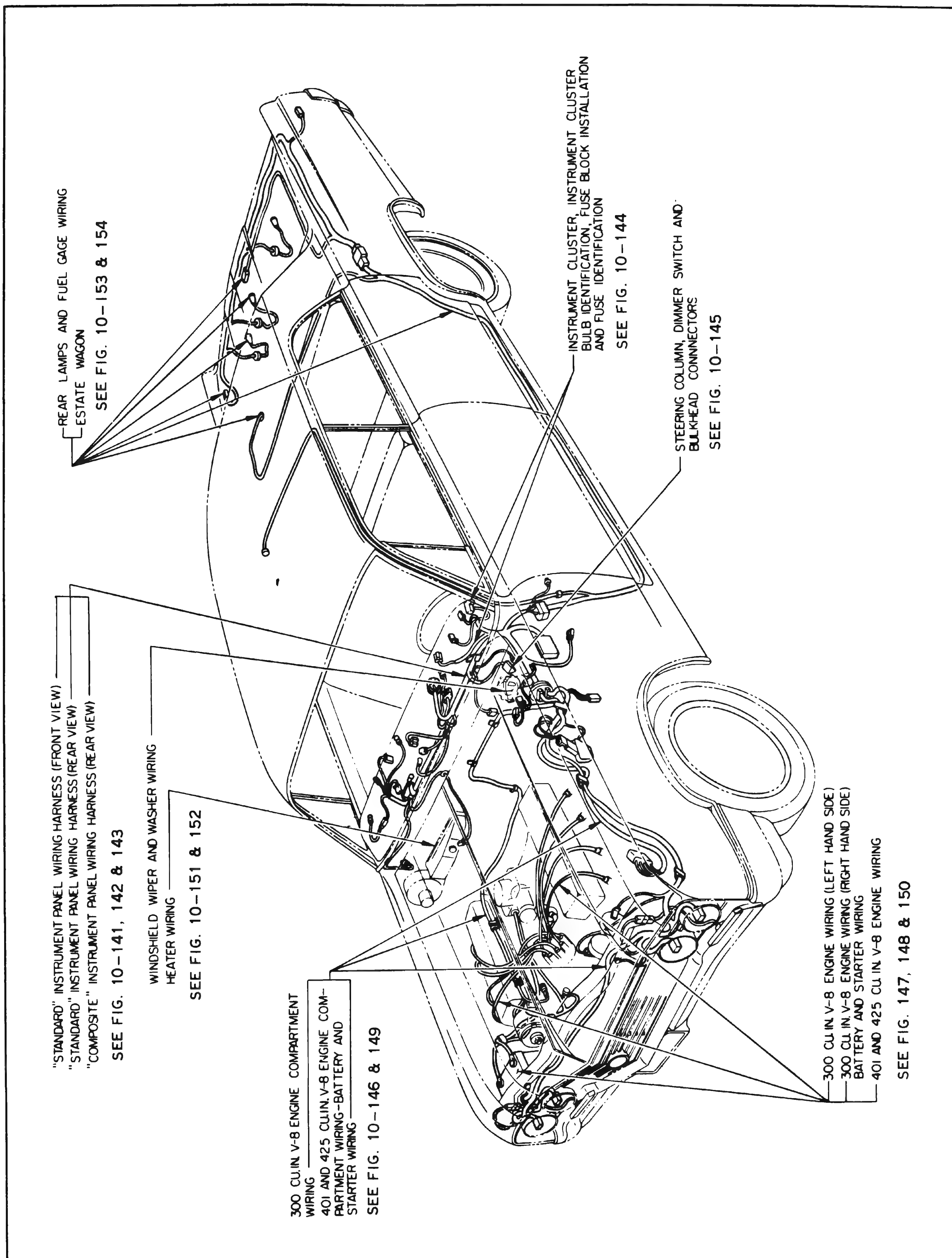


Figure 10-140—Electrical Information—Index

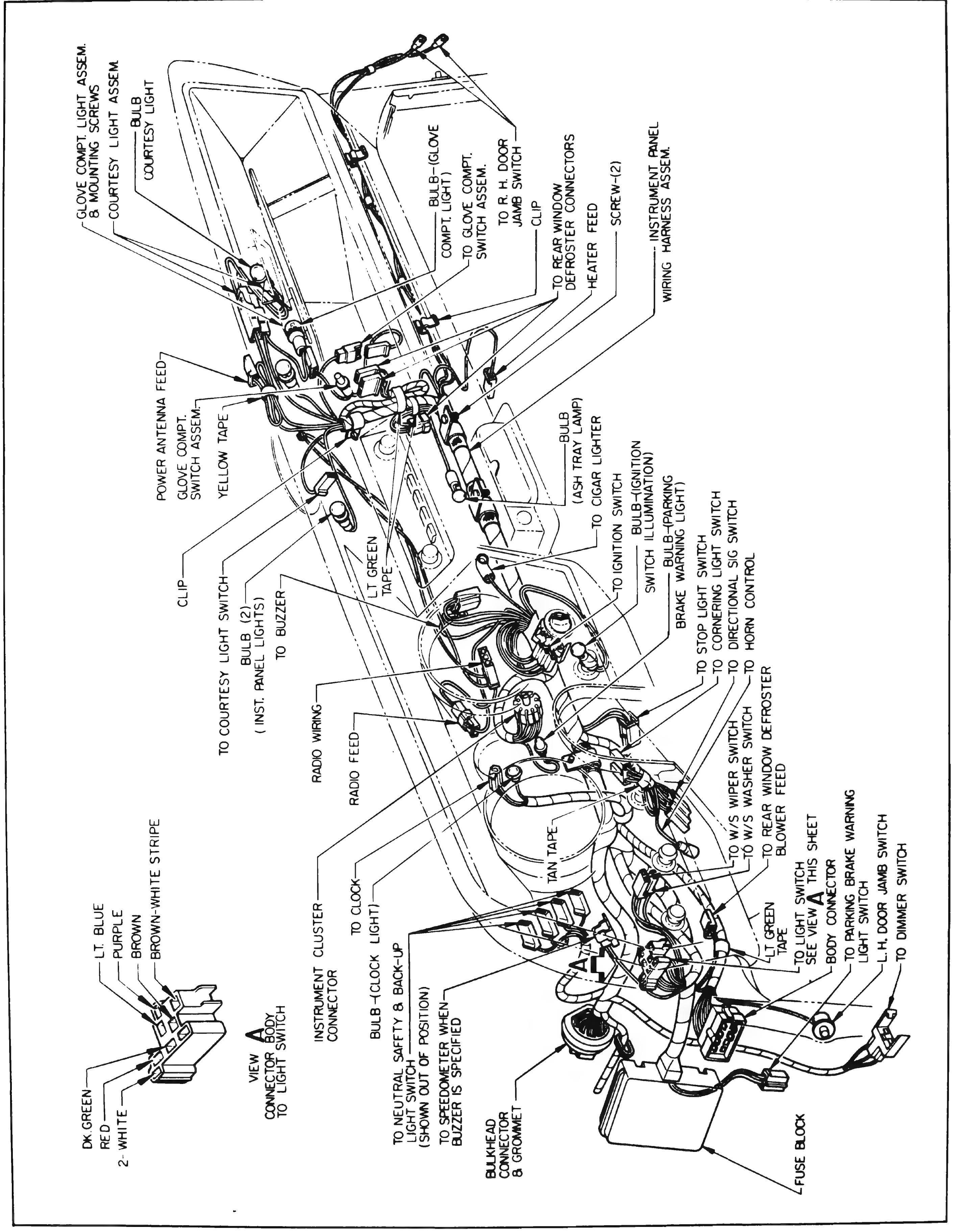


Figure 10-141—Standard Instrument Panel Wiring Harness—View from Passengers' Side

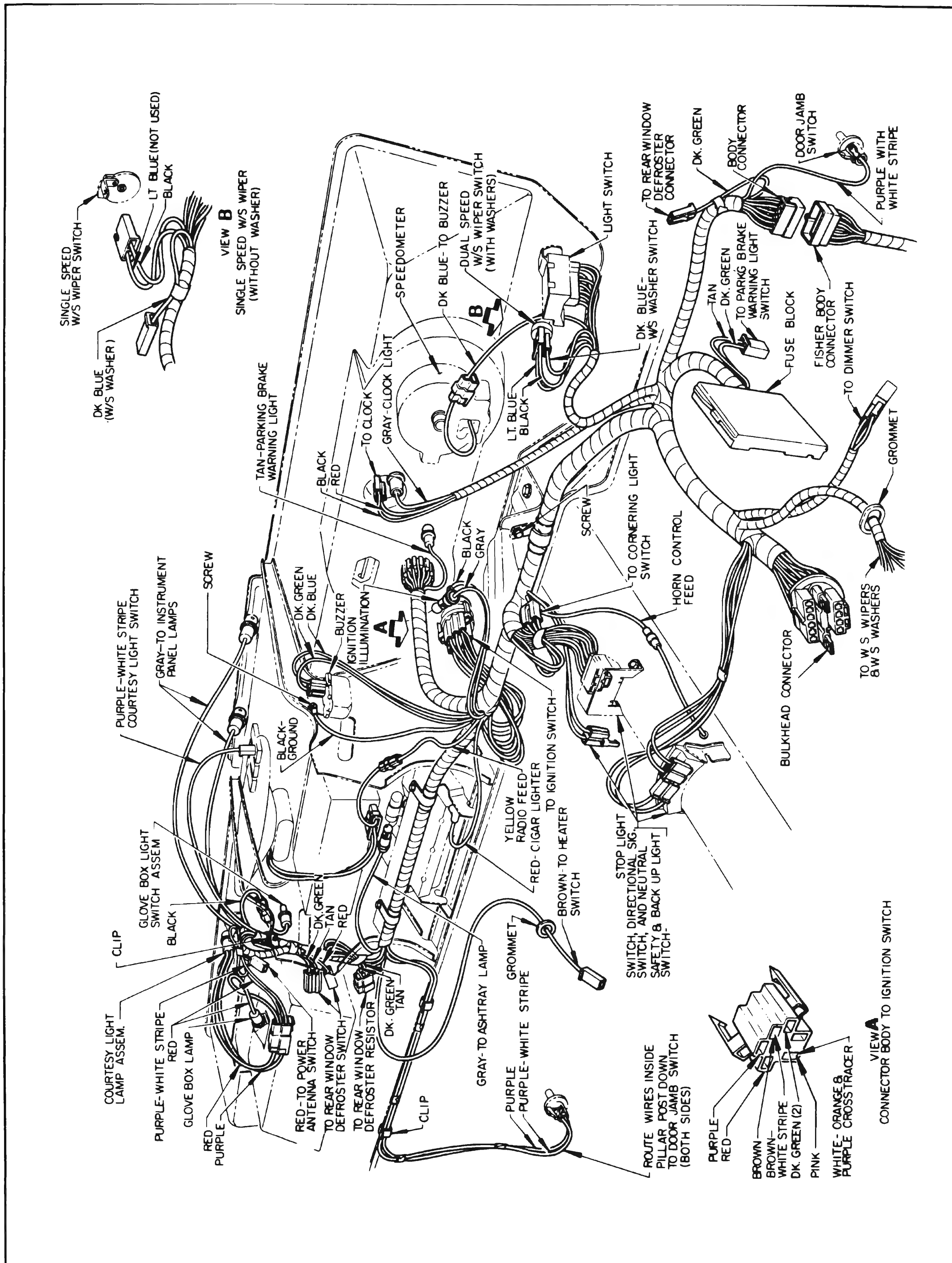


Figure 10-142—Standard Instrument Panel Wiring Harness—View from Forward Side

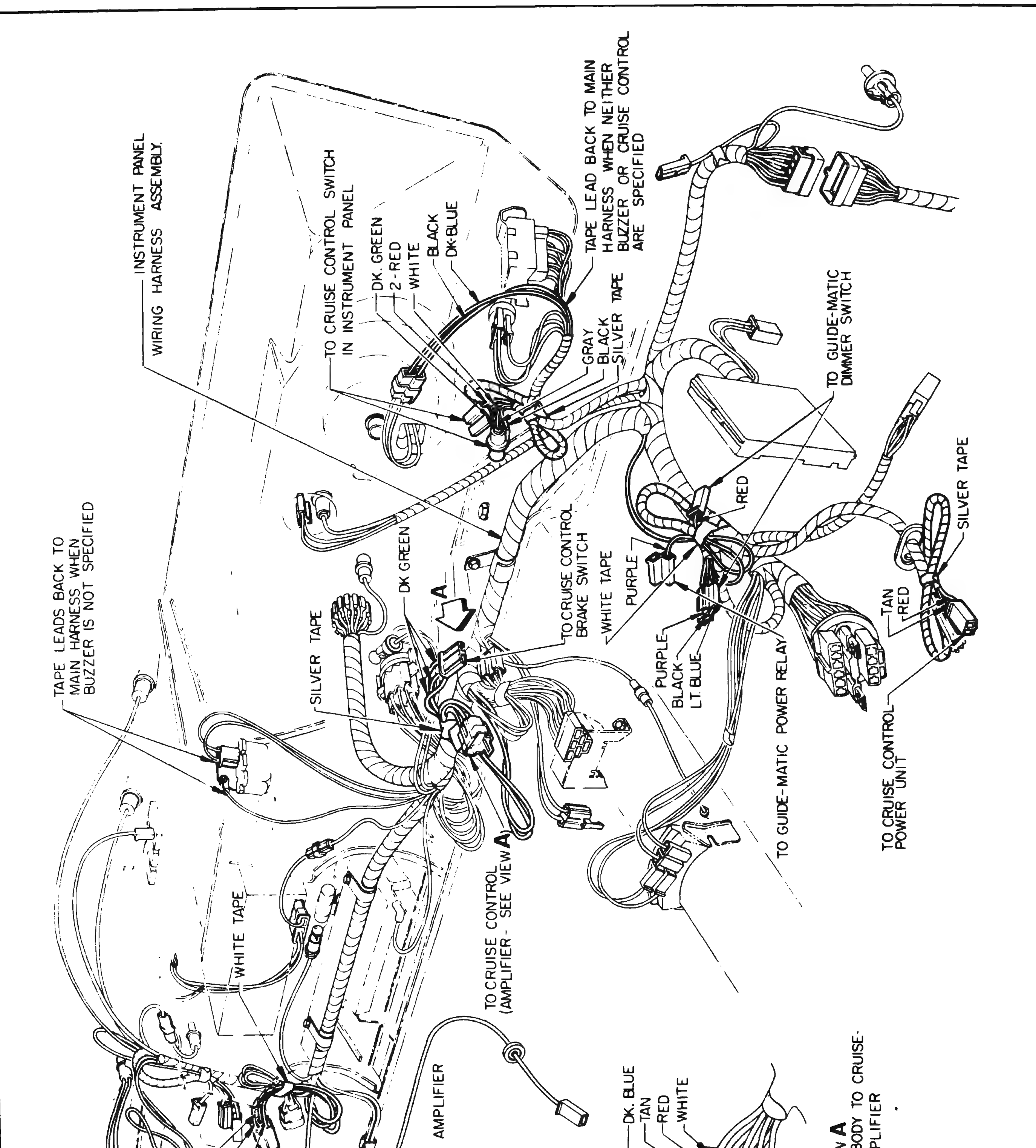


Figure 10-143—Optional Accessory Instrument Panel Wiring Harness

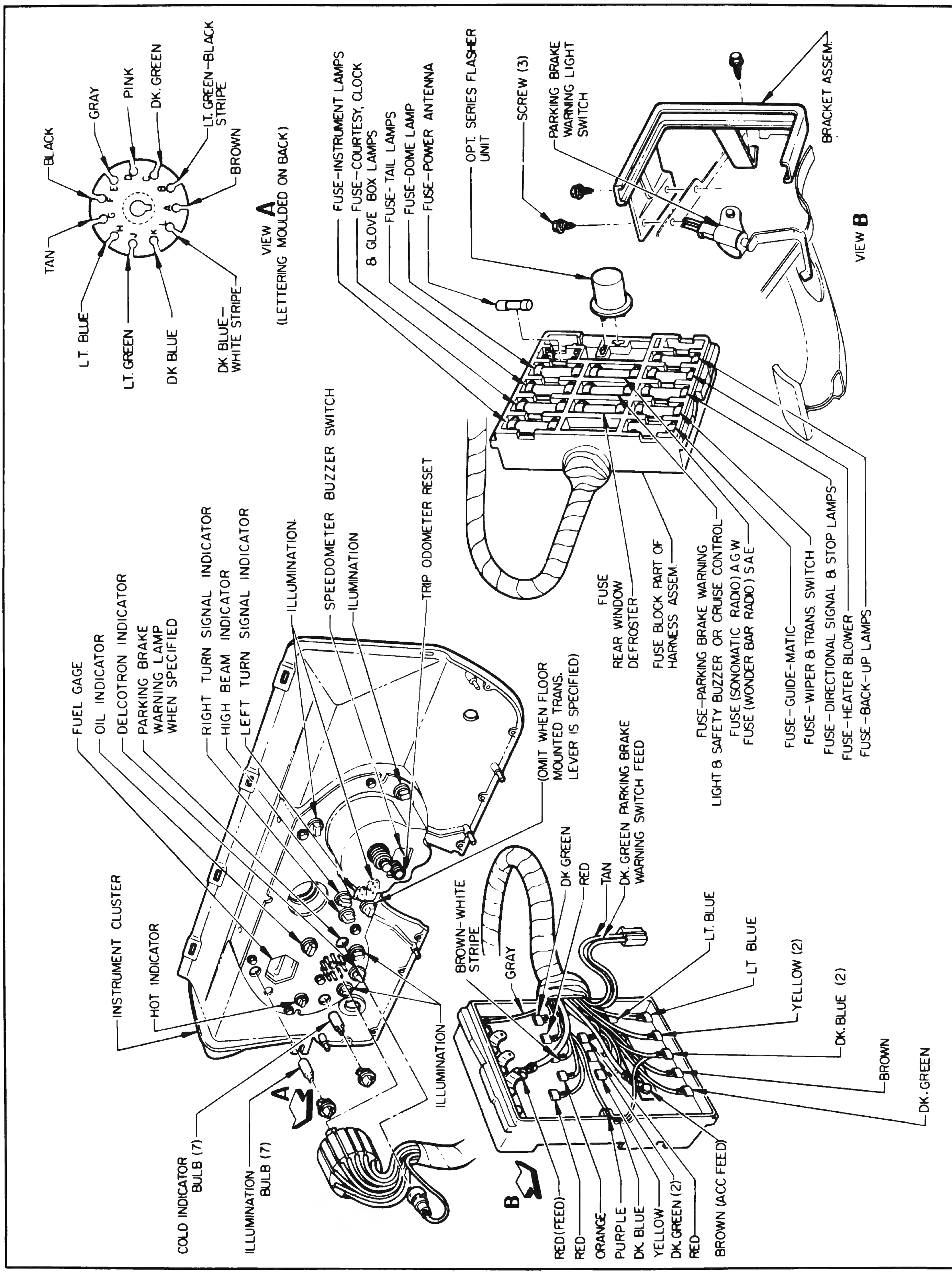


Figure 10-144—Instrument Cluster and Bulbs, Fuse Block and Fuses

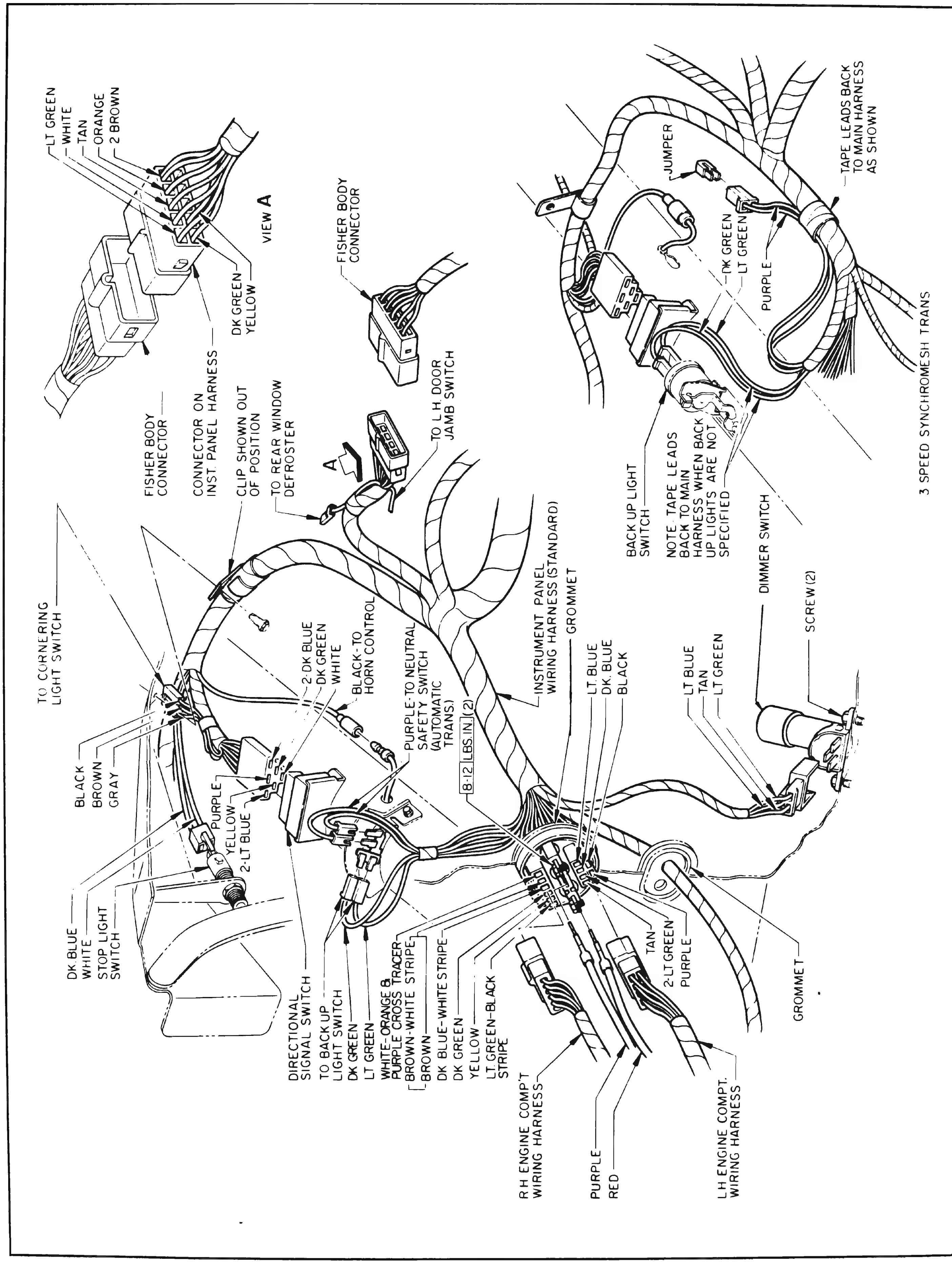


Figure 10-145—Bulkhead and Body Connectors, Turn Signal, Neutral Safety and Dimmer Switches

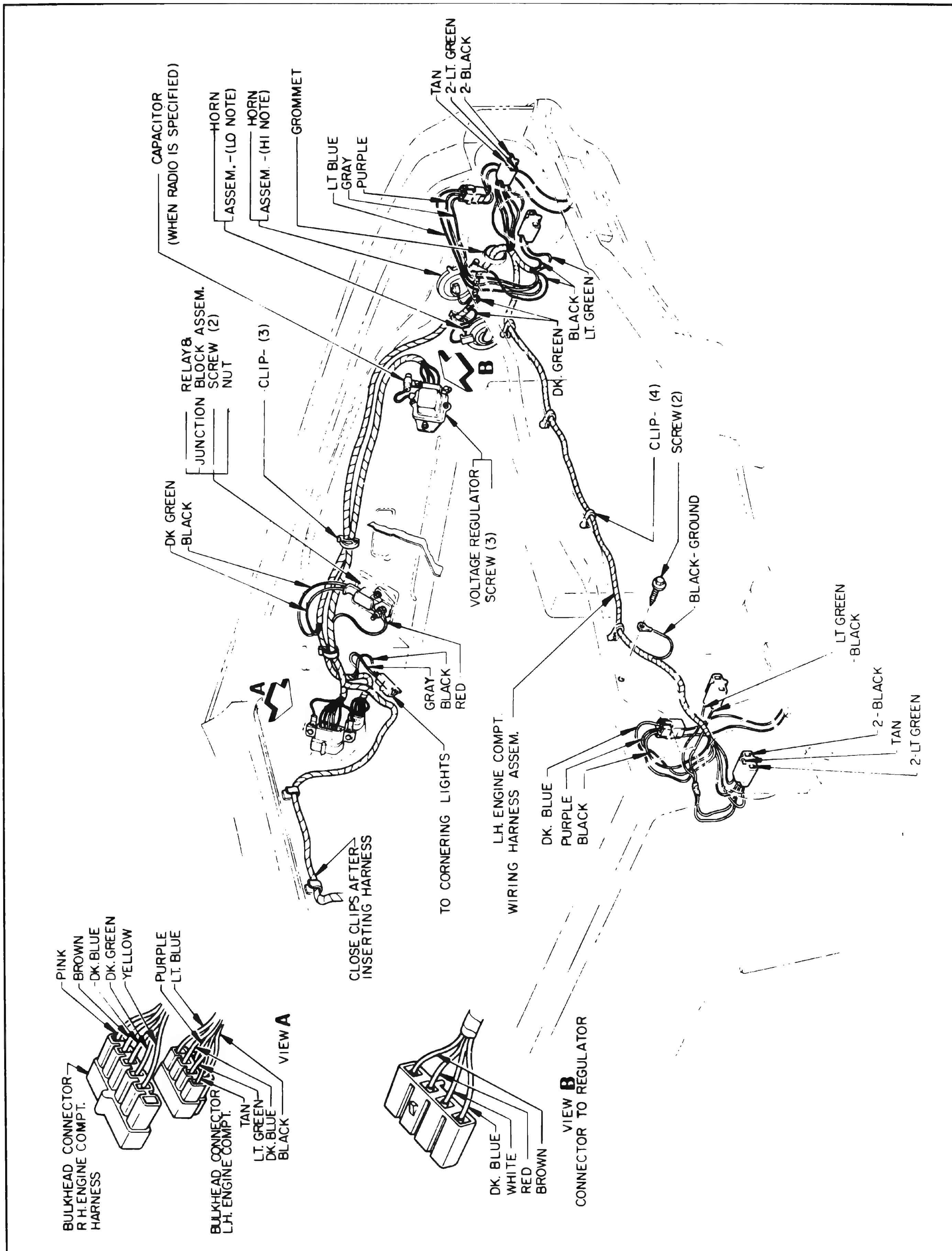


Figure 10-146—300 Engine Compartment Wiring

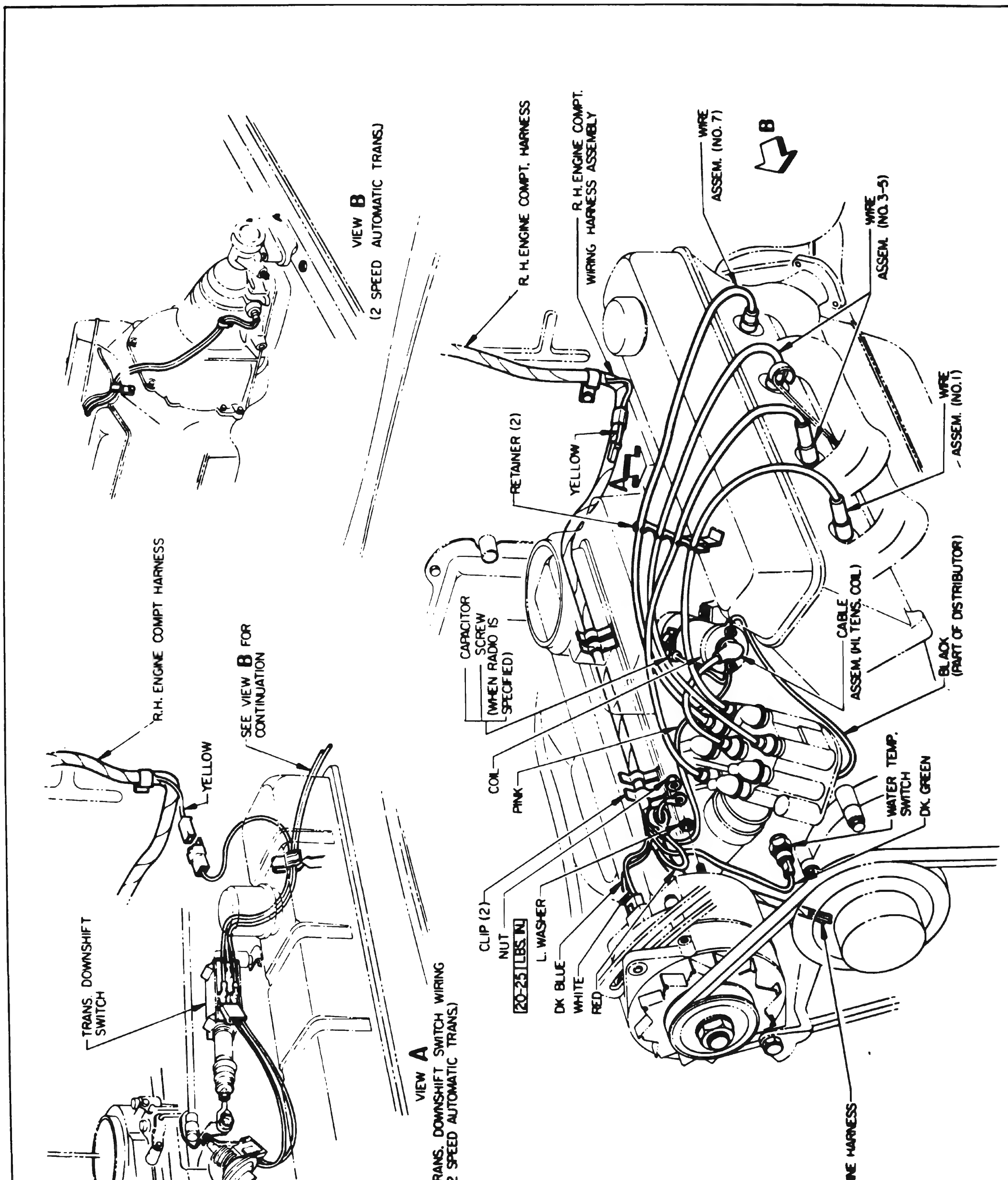


Figure 10-147—300 Engine Left Side Wiring

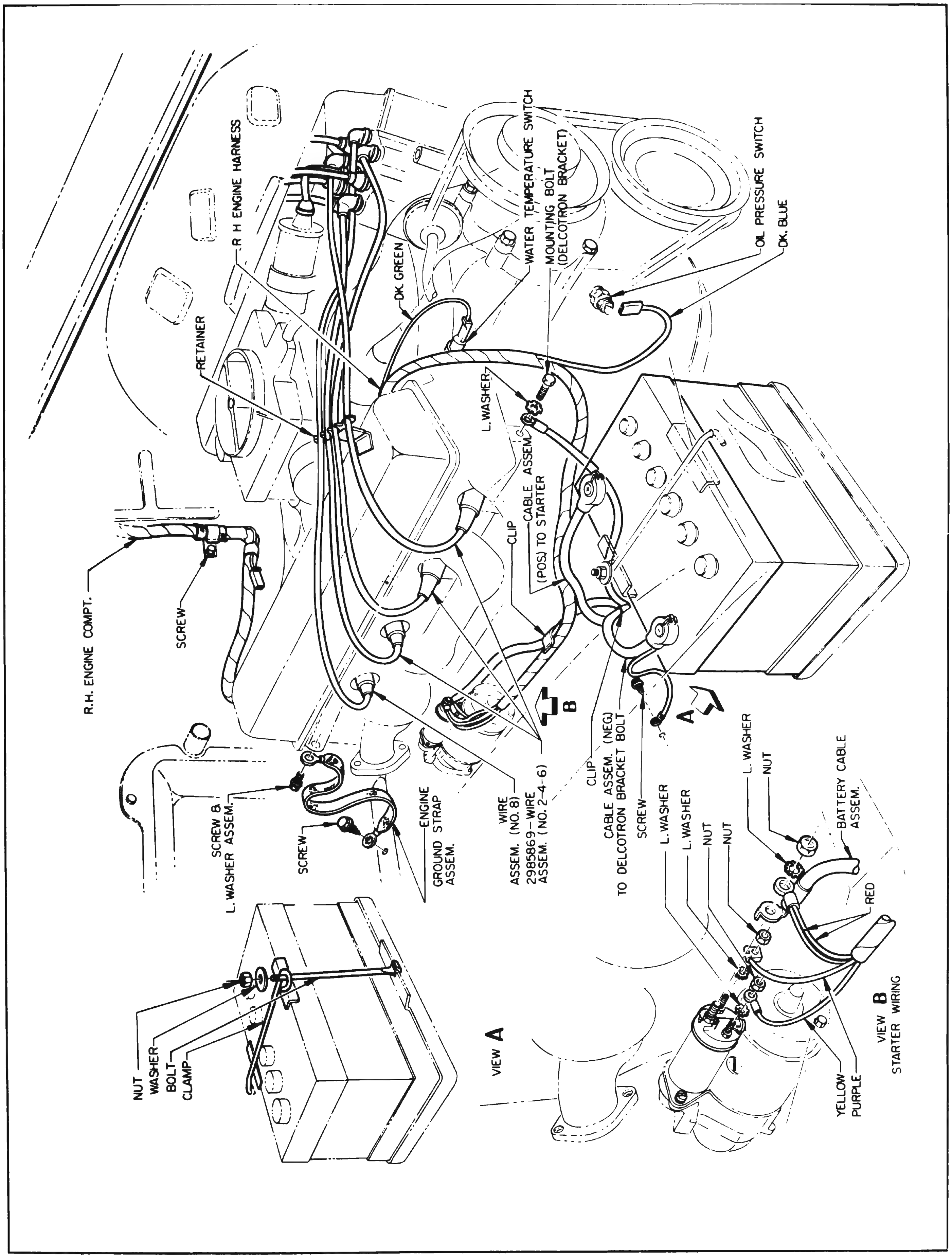


Figure 10-148—300 Engine Right Side Wiring

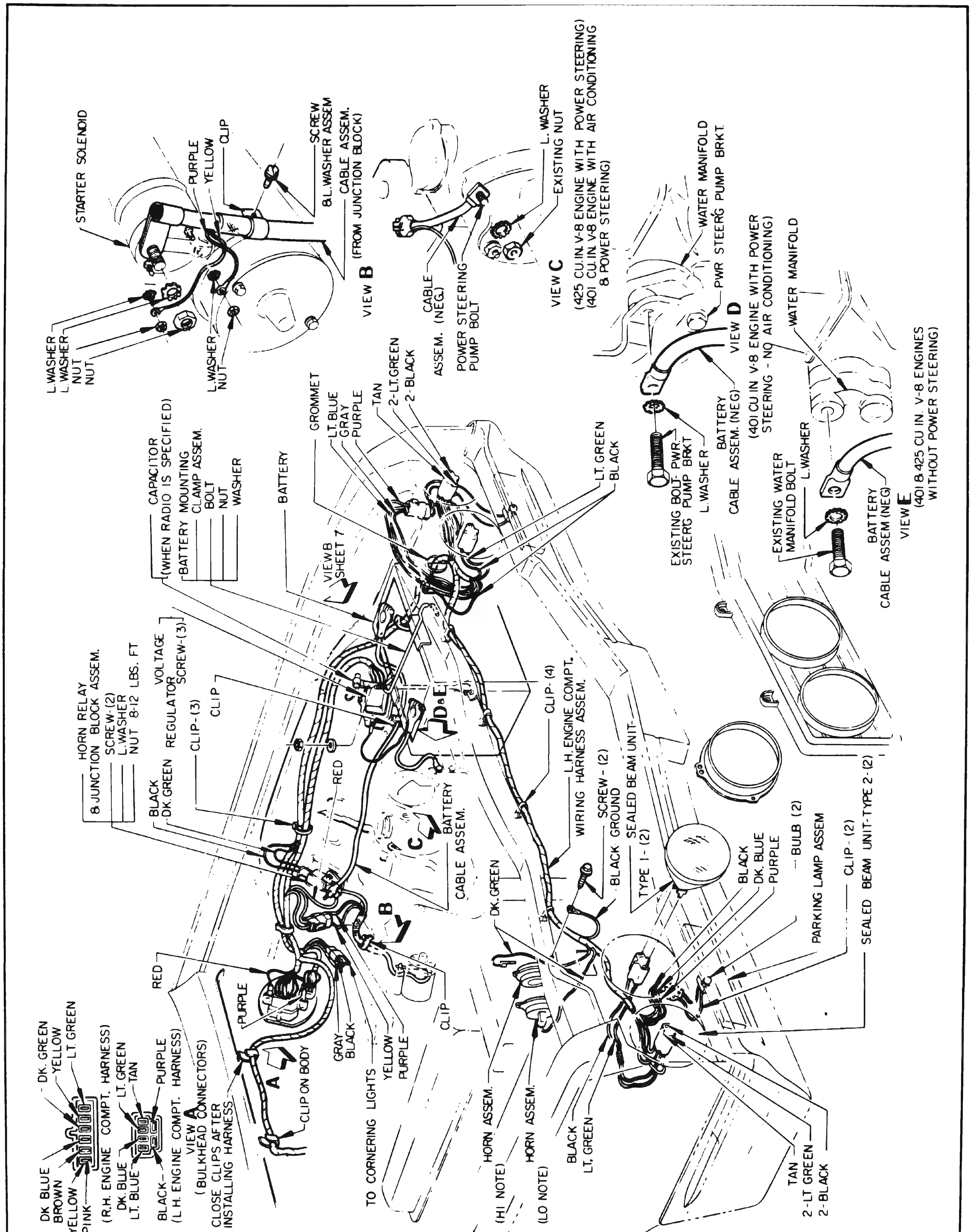


Figure 10-149—401 and 425 Engine Compartment Wiring

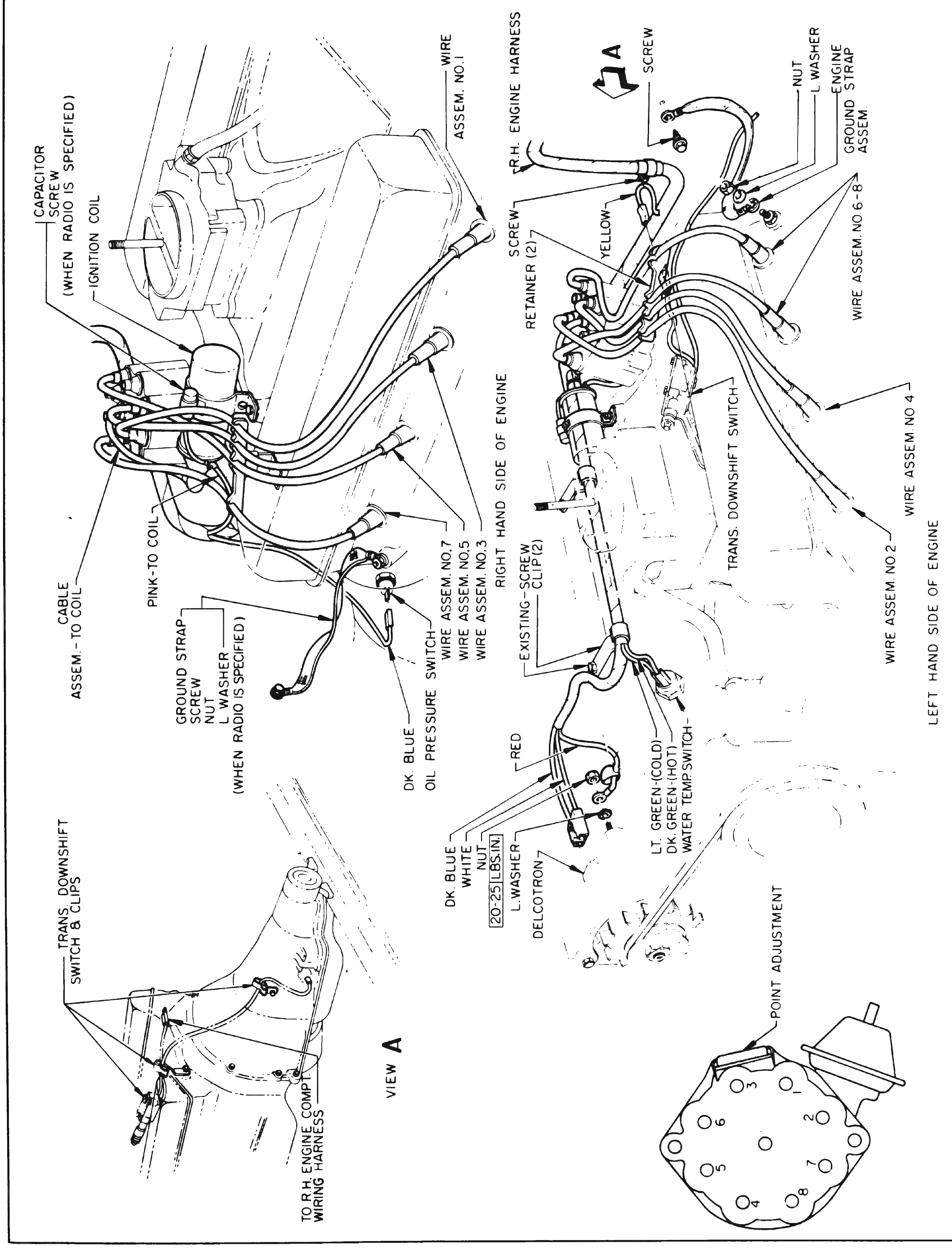


Figure 10-150—401 and 425 Engine Wiring

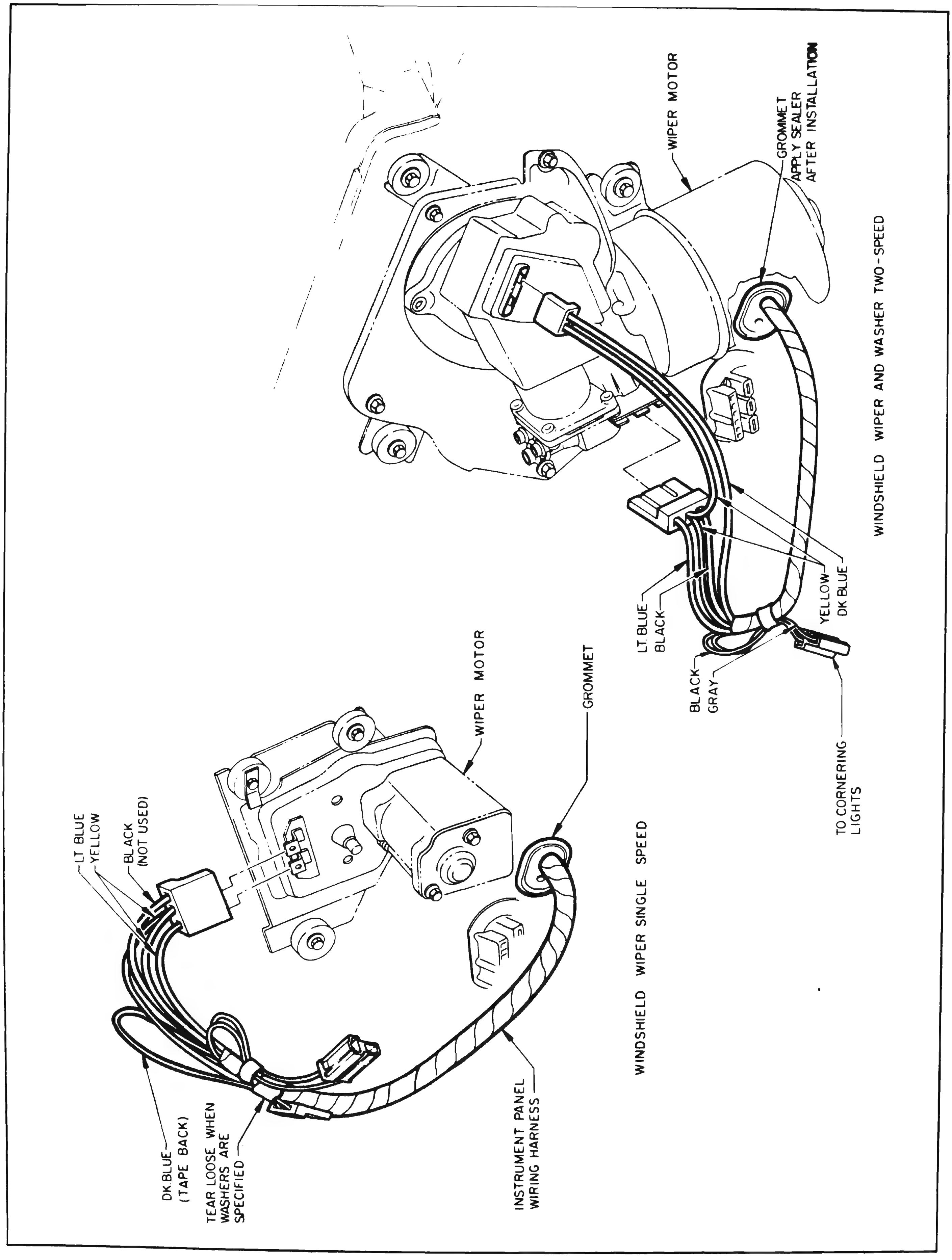


Figure 10-151—Windshield Wiper and Washer Wiring

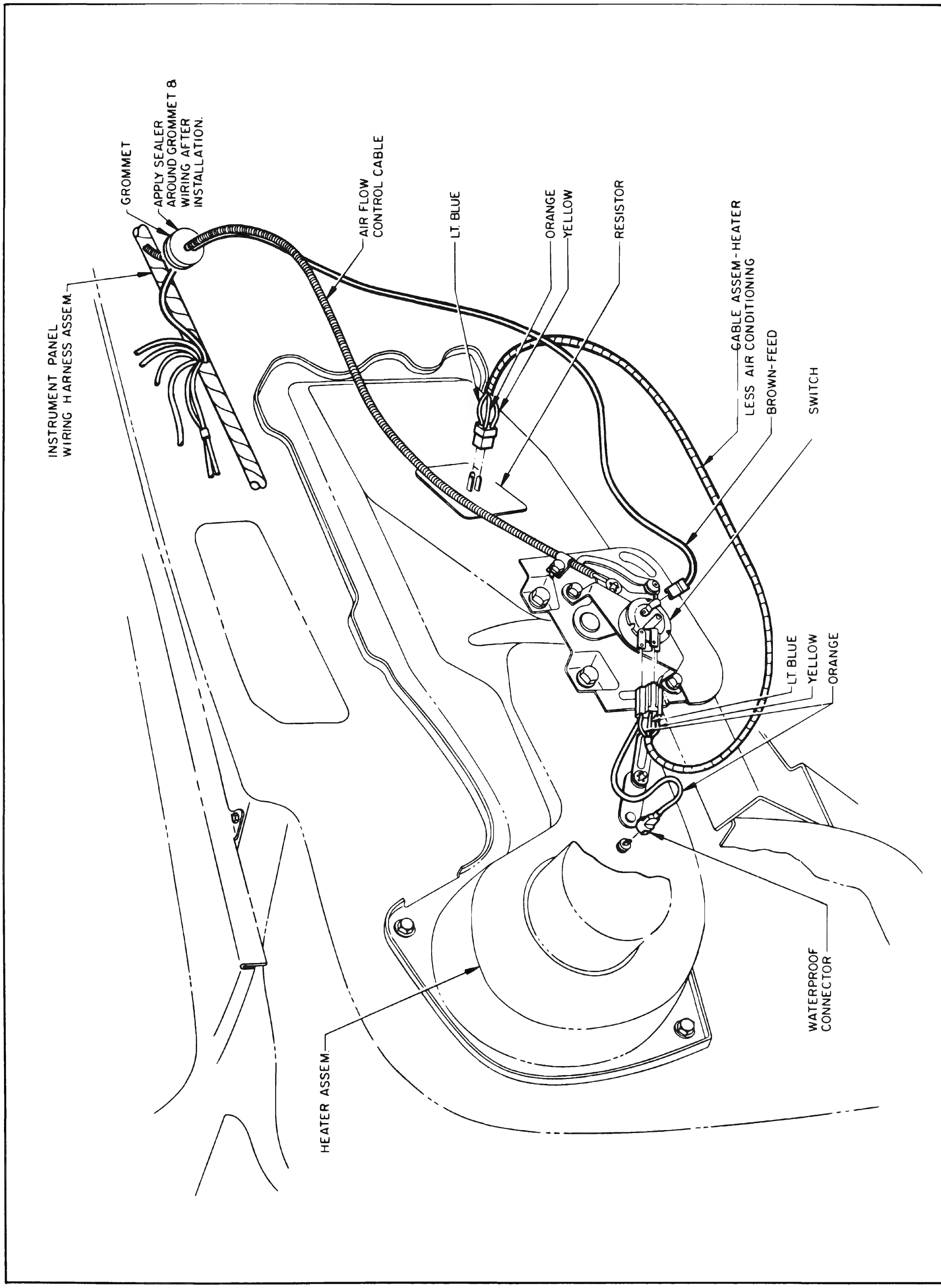


Figure 10-152—Heater Wiring

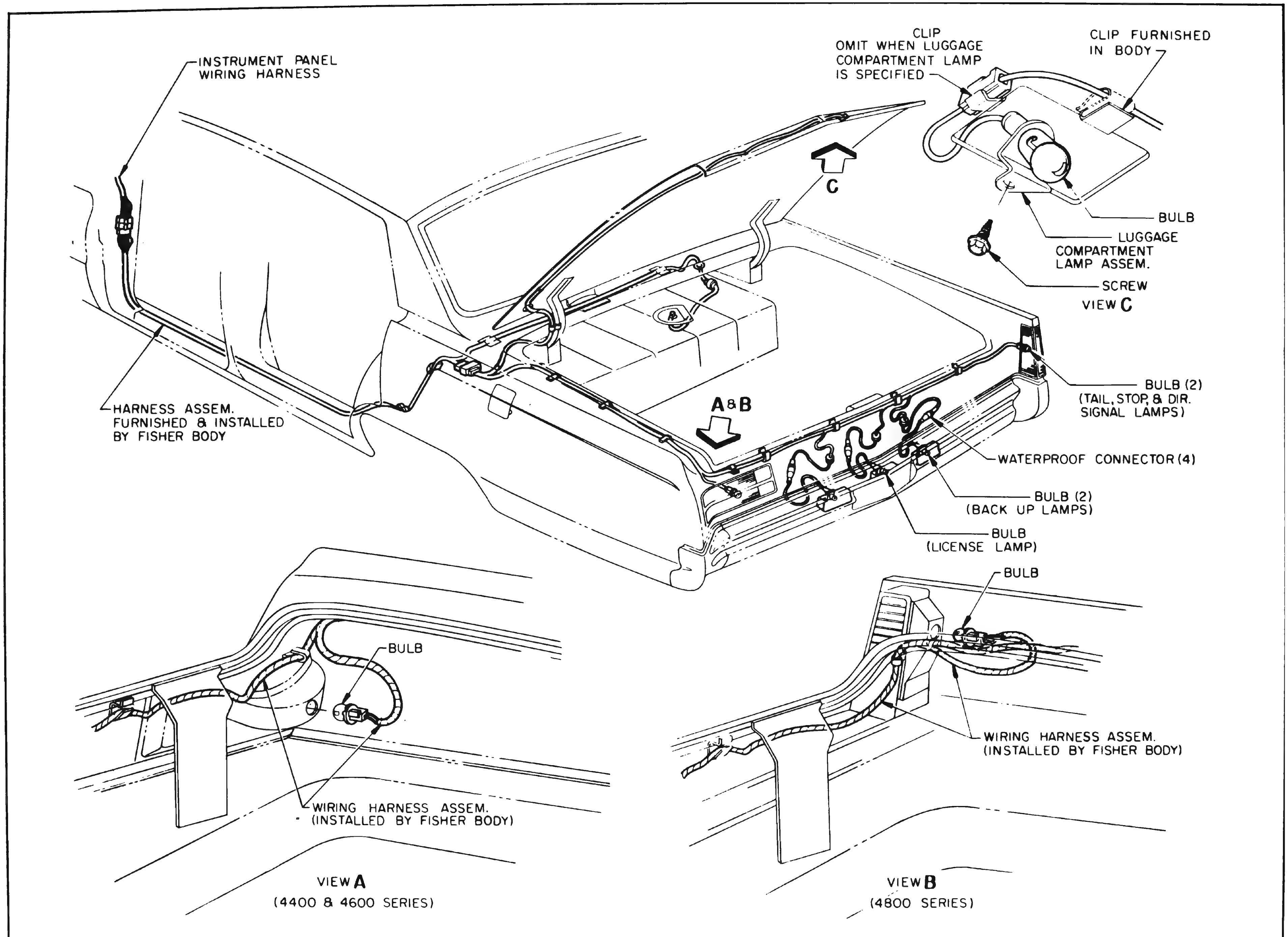


Figure 10-153—Rear Lamps and Fuel Gauge Wiring

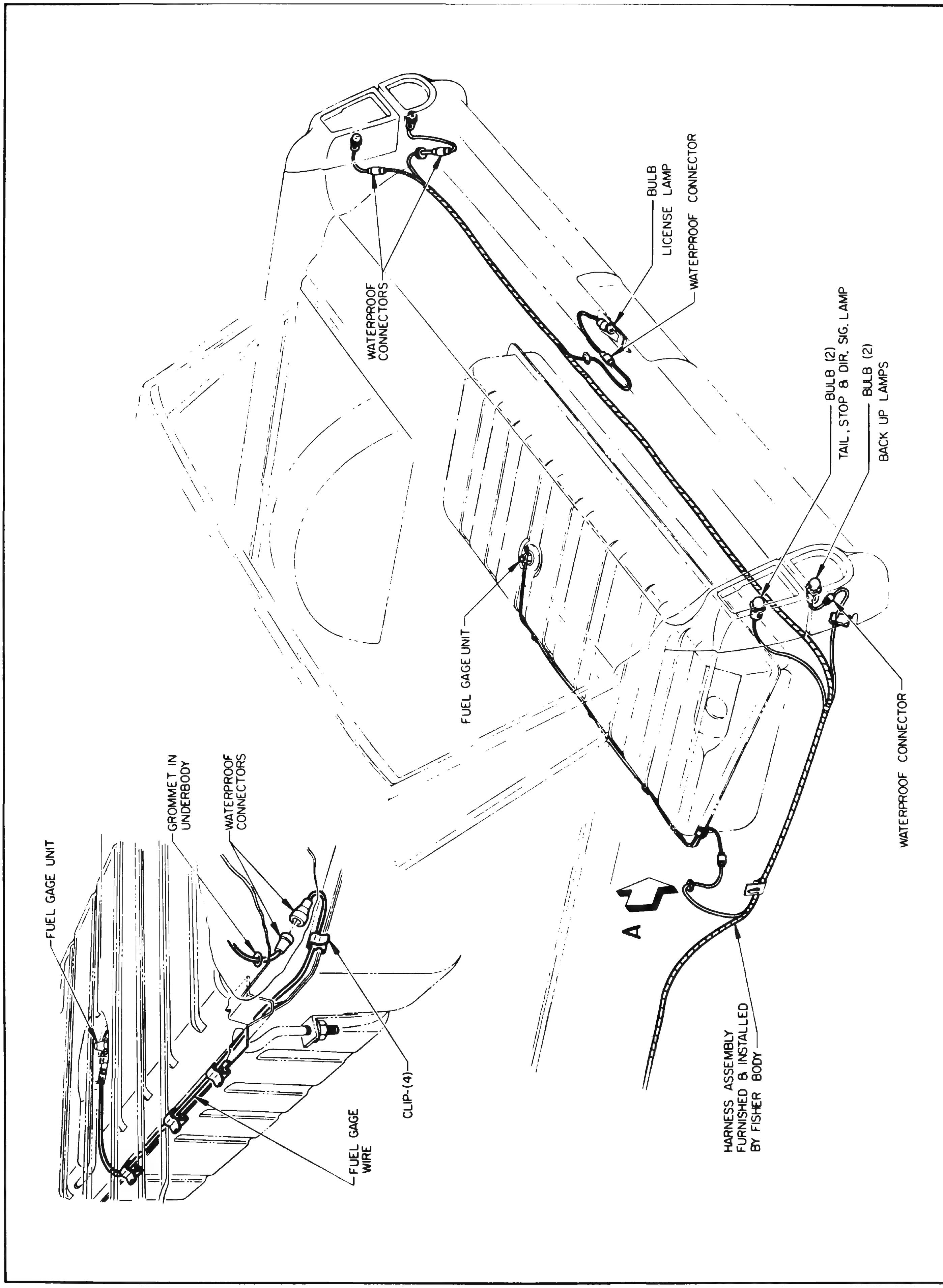


Figure 10-154—Rear Lamps and Fuel Gauge Wiring—Wagons

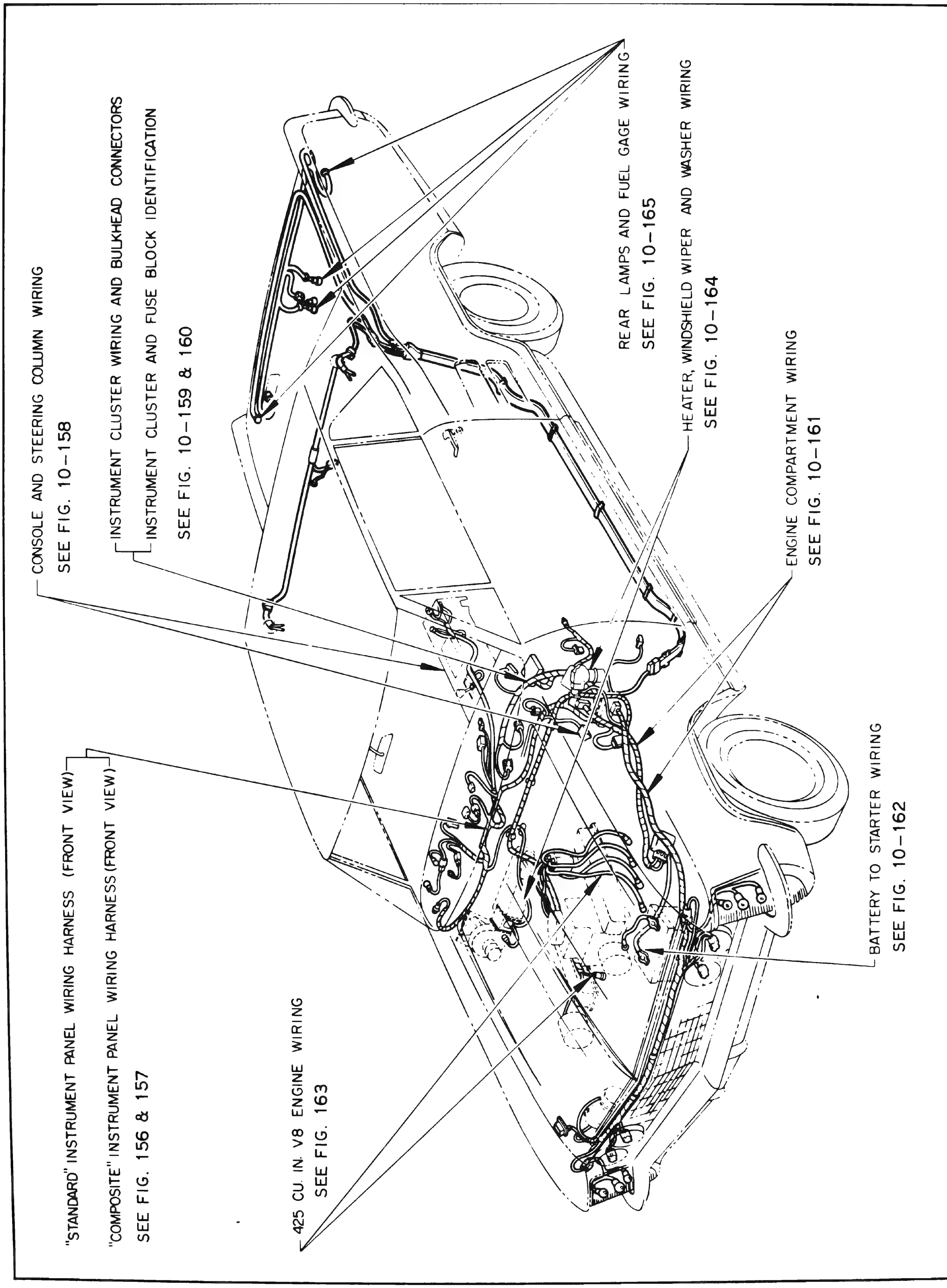


Figure 10-155—Electrical Information Index—Riviera

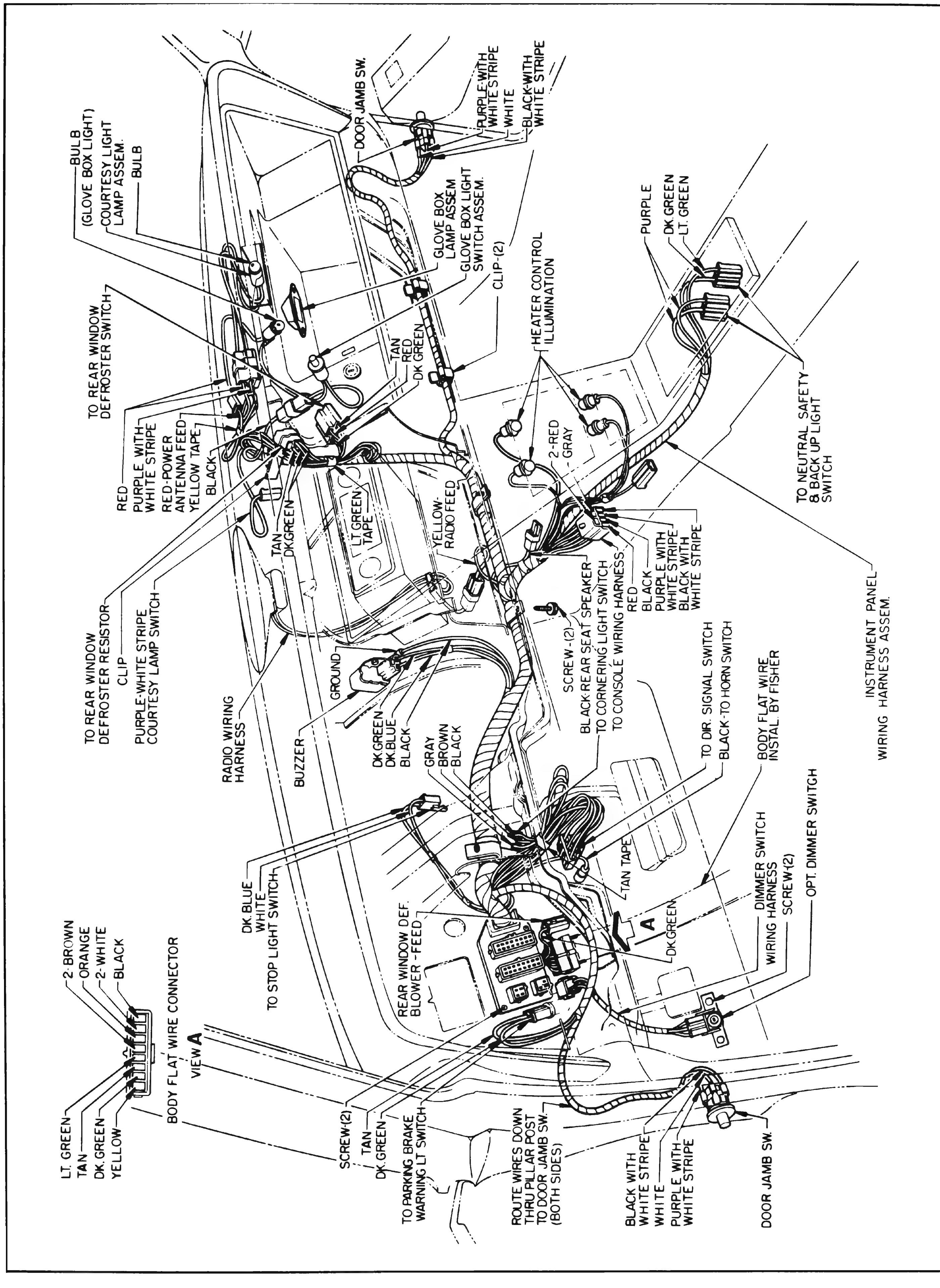


Figure 10-156—Standard Instrument Panel Wiring Harness—Riviera

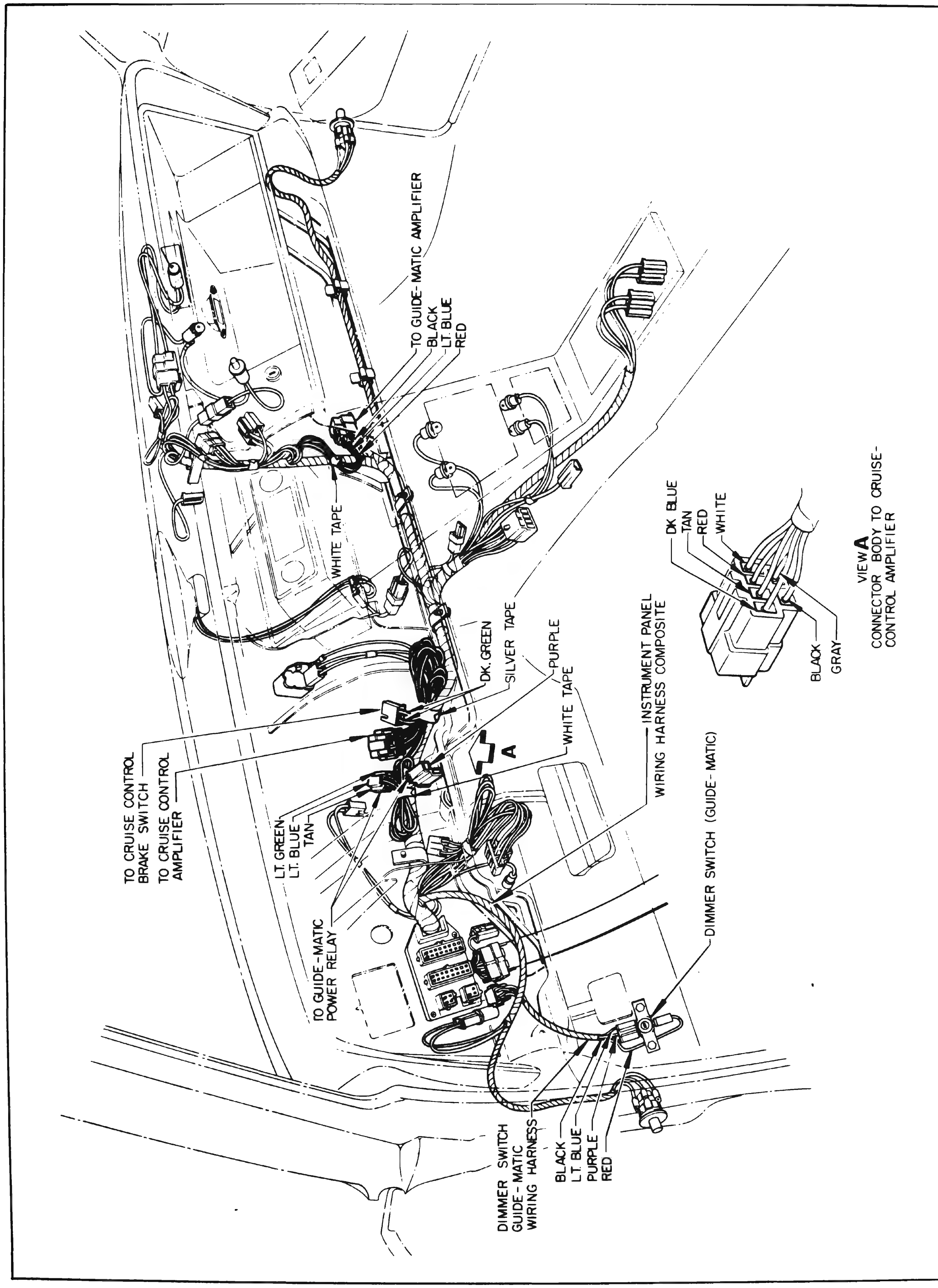


Figure 10-157—Optional Accessory Instrument Panel Wiring Harness—Riviera

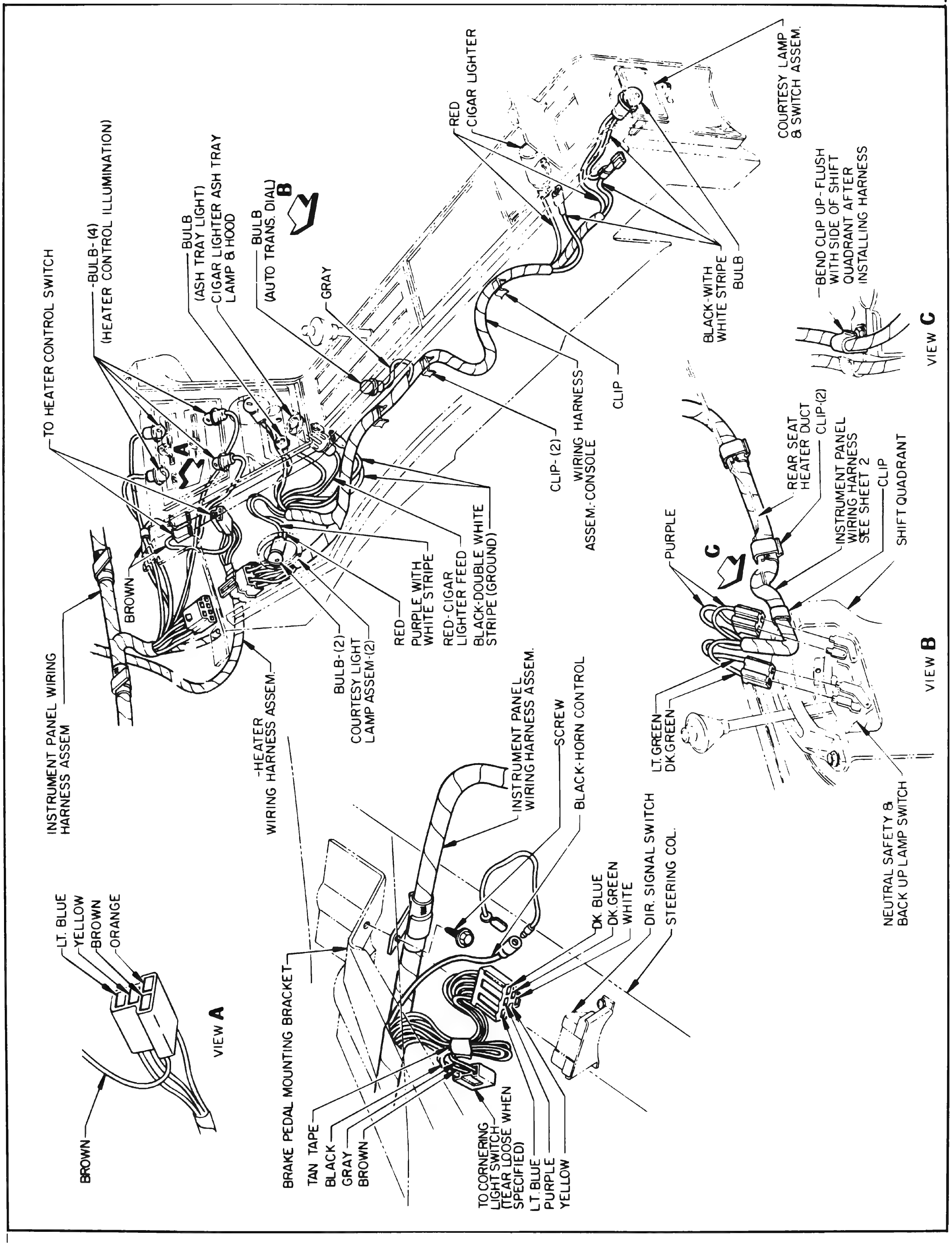


Figure 10-158—Console and Steering Column Wiring—Riviera

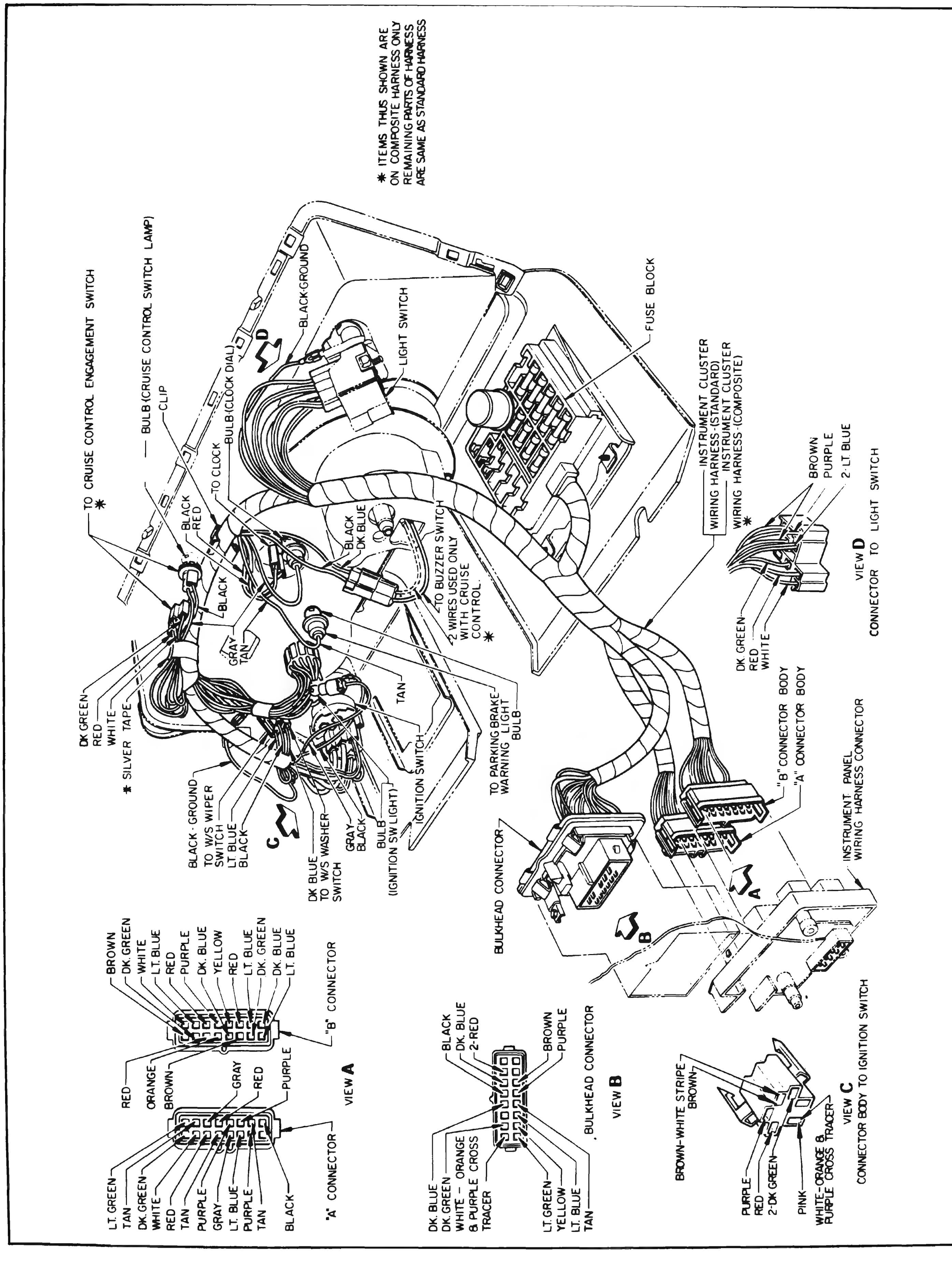


Figure 10-159—Instrument Cluster Wiring and Bulkhead Connectors—Riviera

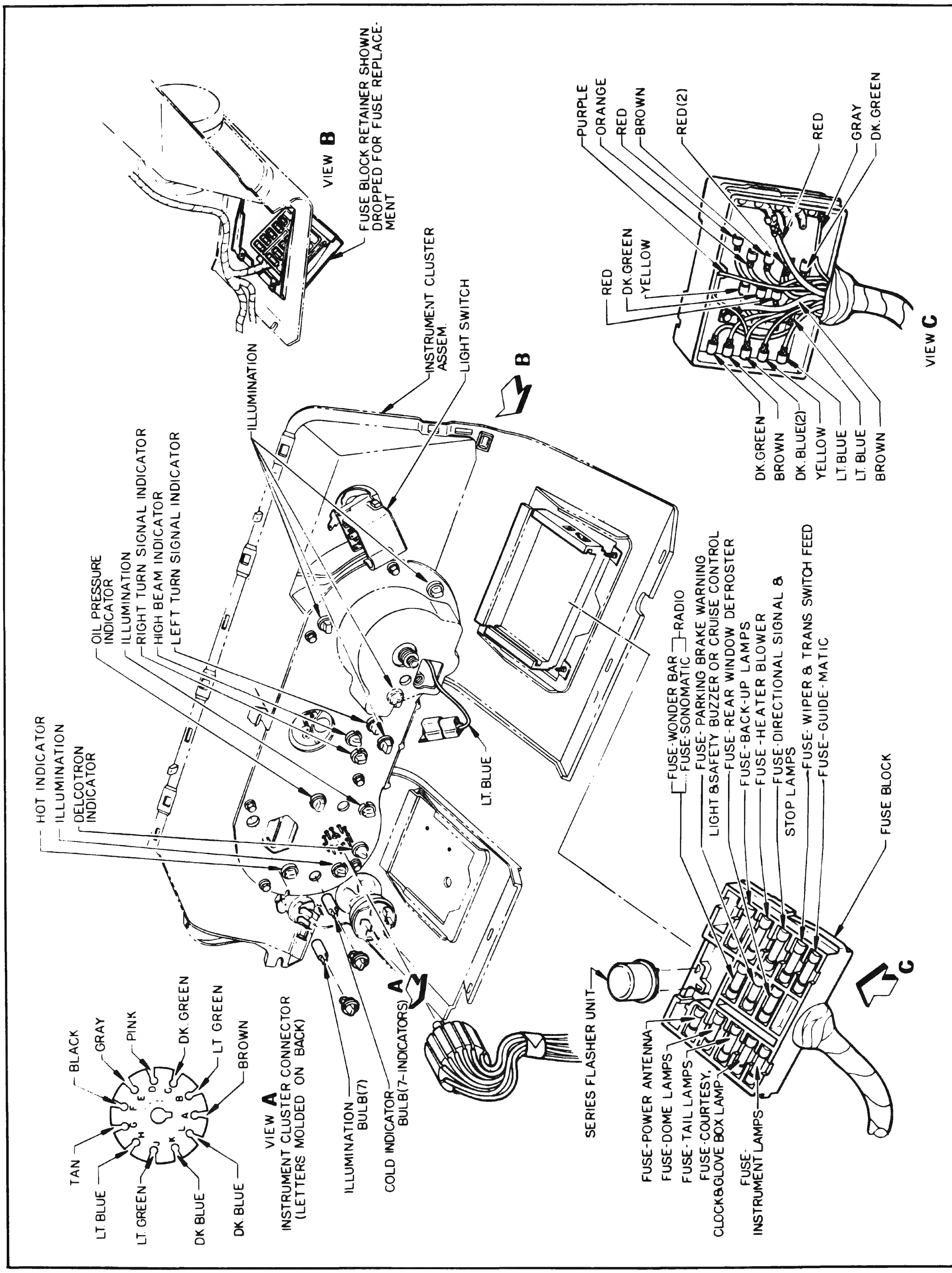


Figure 10-160—Instrument Cluster and Bulbs, Fuse Block and Fuses—Riviera

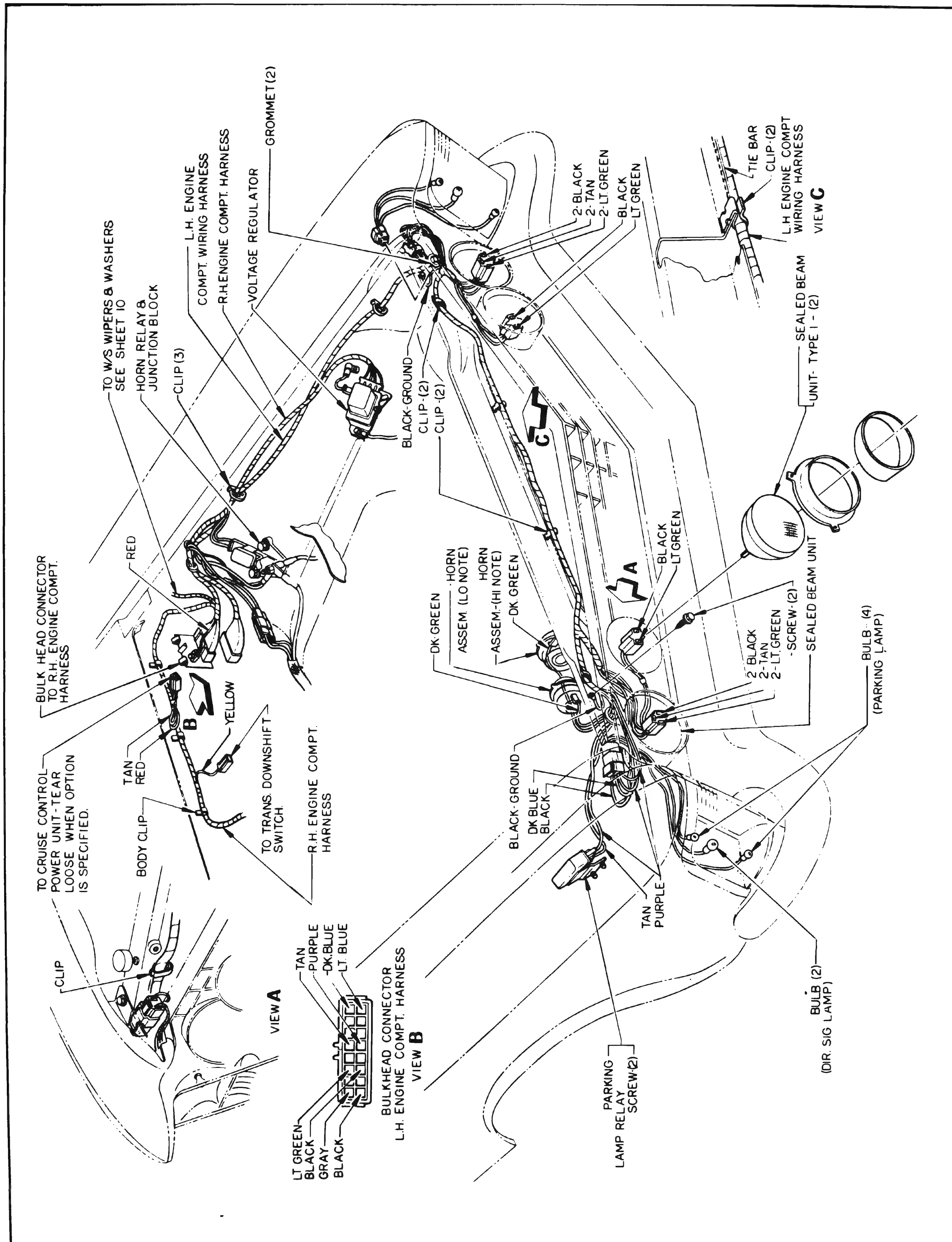


Figure 10-161—Engine Compartment Wiring—Riviera

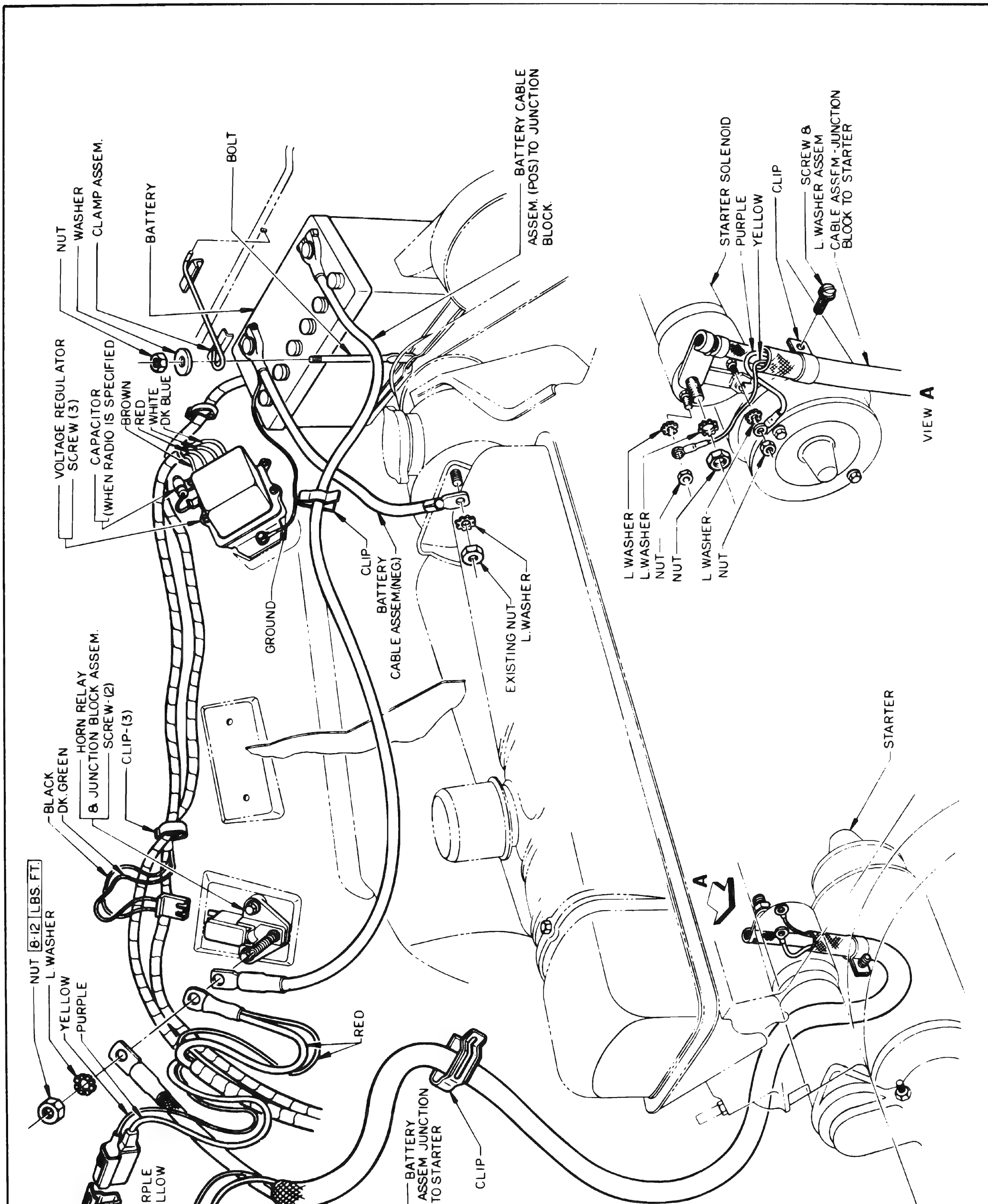


Figure 10-162—Starter, Battery, Voltage Regulator, Horn Relay and Junction Block—Riviera

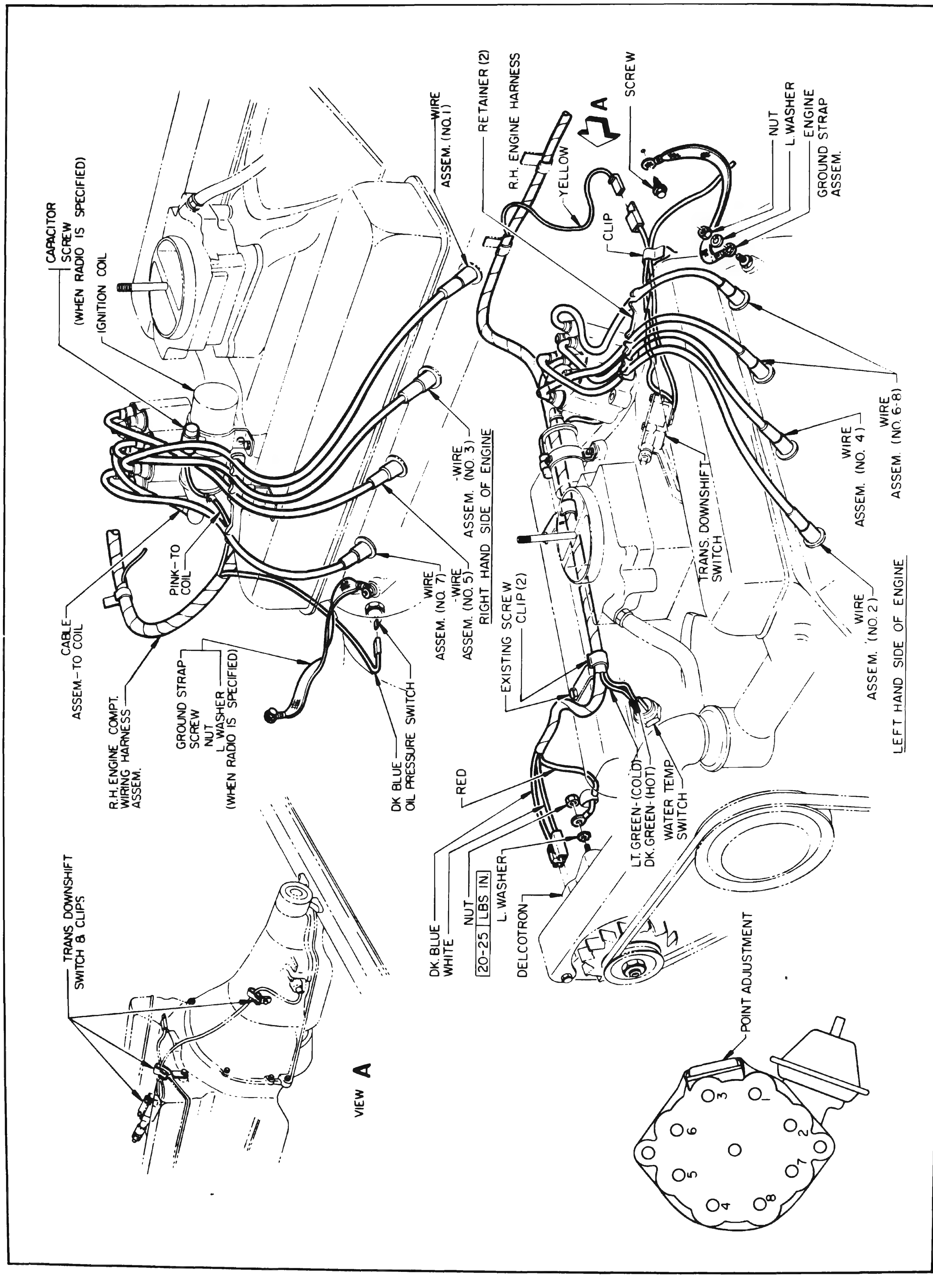


Figure 10-163—Engine Wiring—Riviera

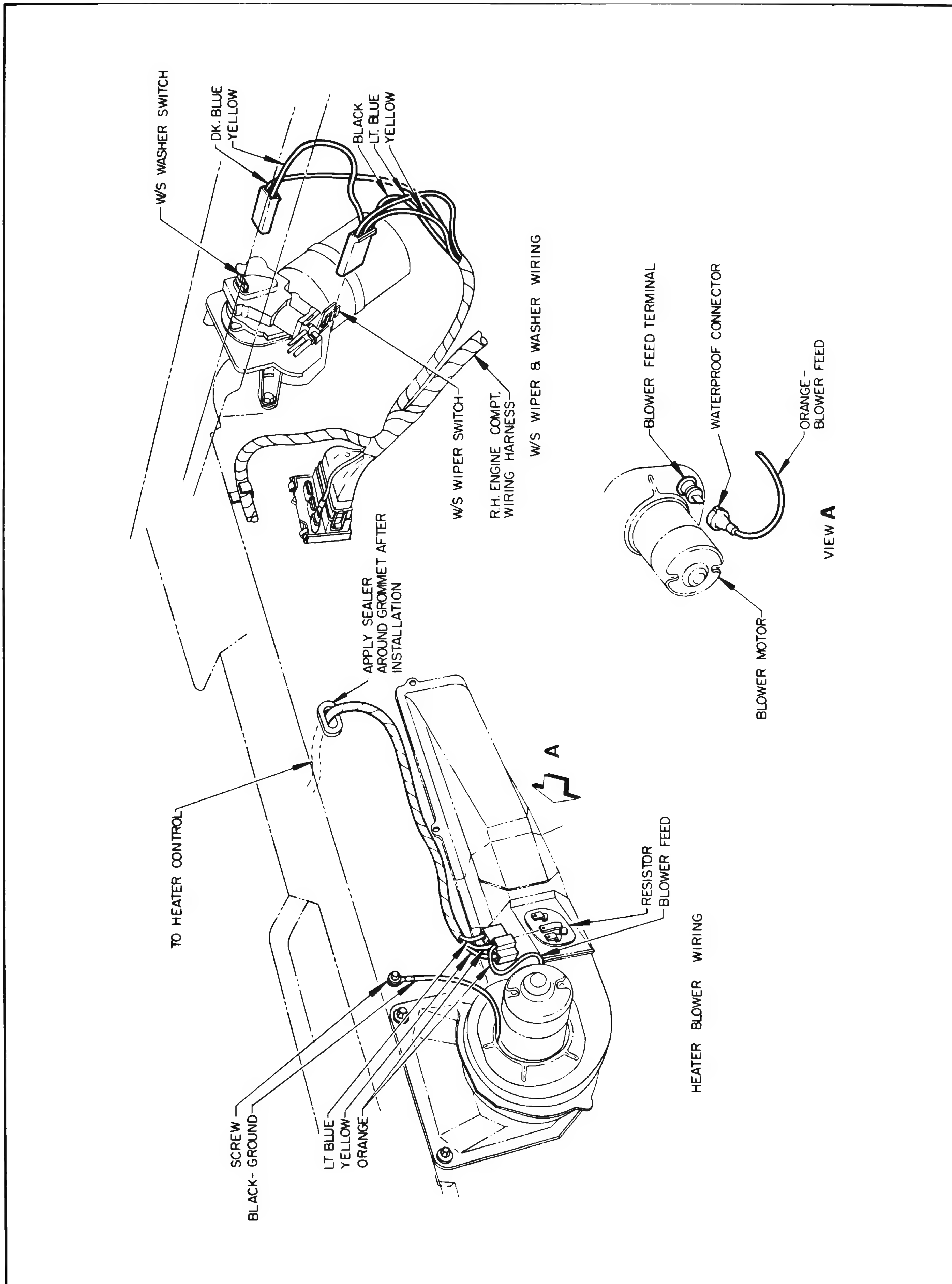


Figure 10-164—Heater, Windshield Wiper and Washer Wiring—Riviera

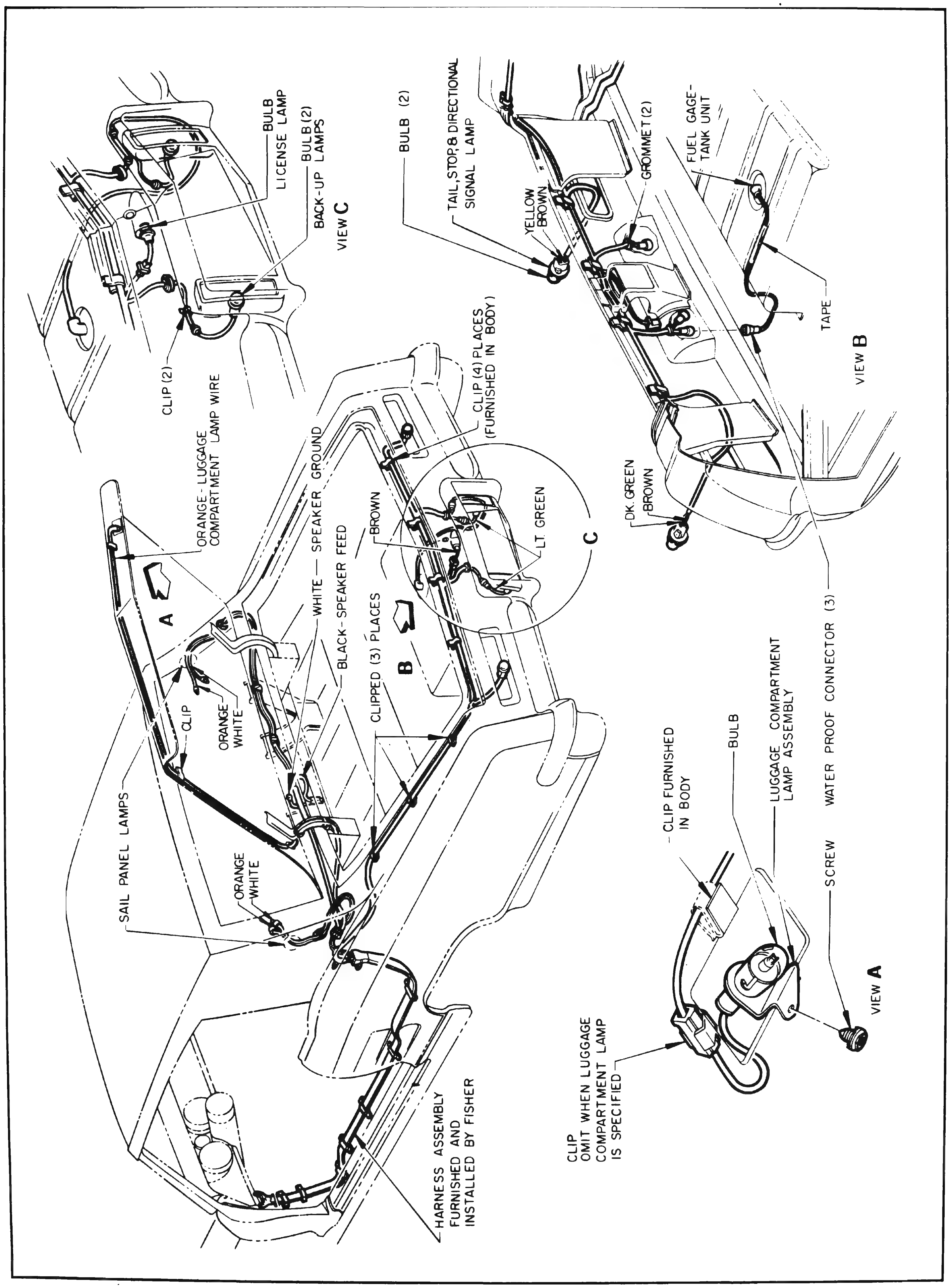


Figure 10-165—Rear Lamp and Fuel Gauge Wiring—Riviera

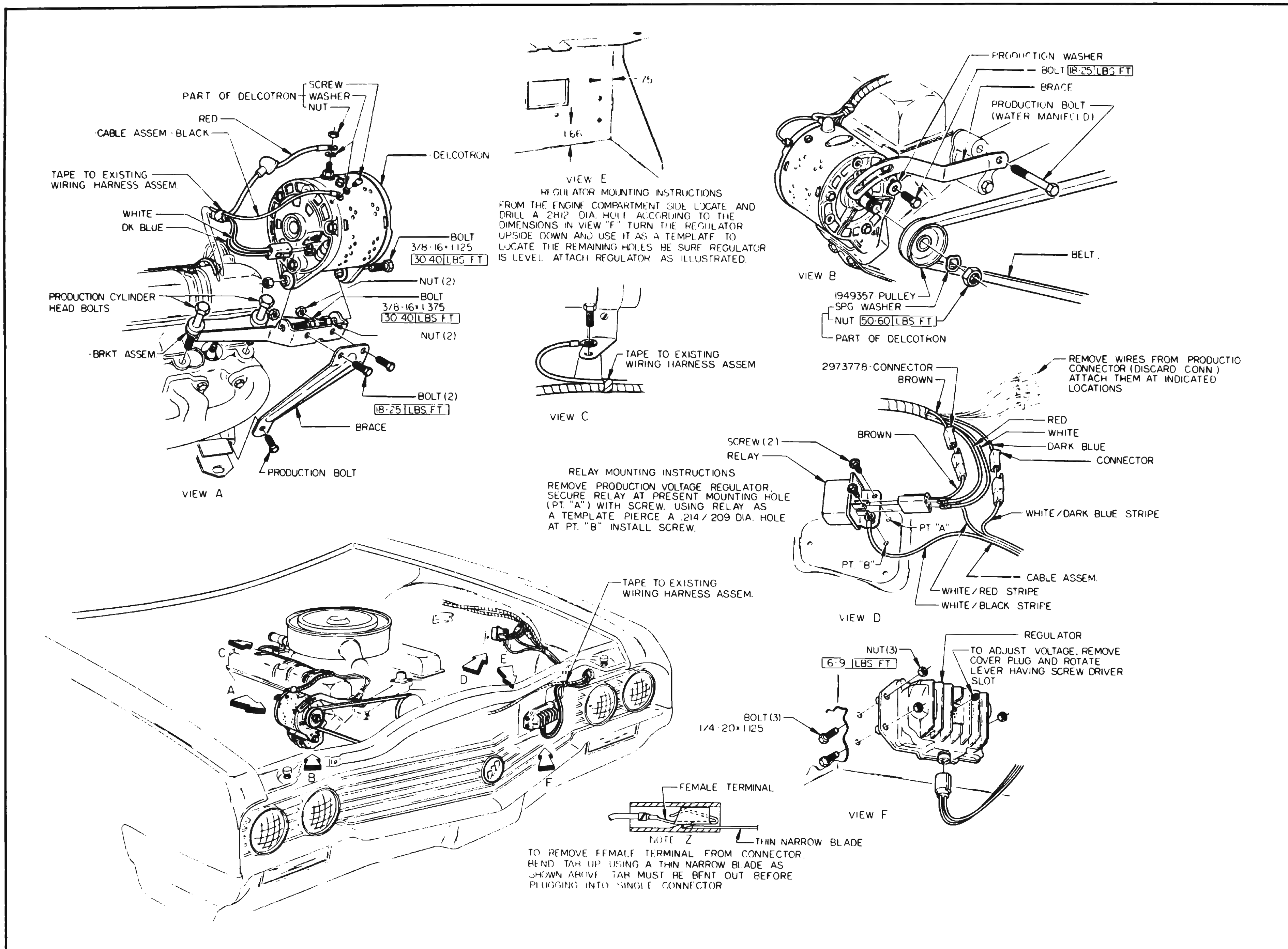


Figure 10-166—Police Car Generator Installation

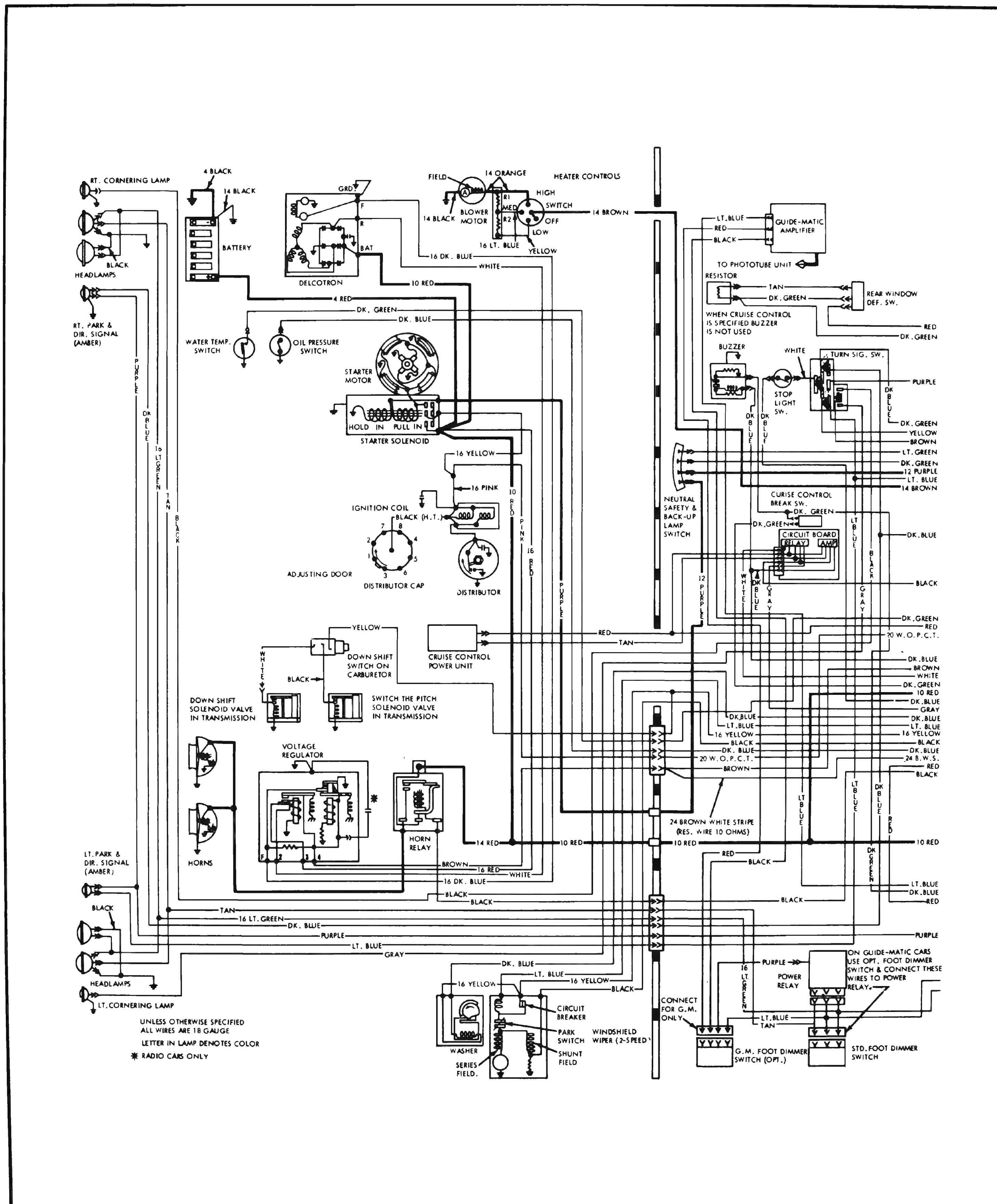


Figure 10-167—Chassis Wiring Diagram—Front Half 4400 Series

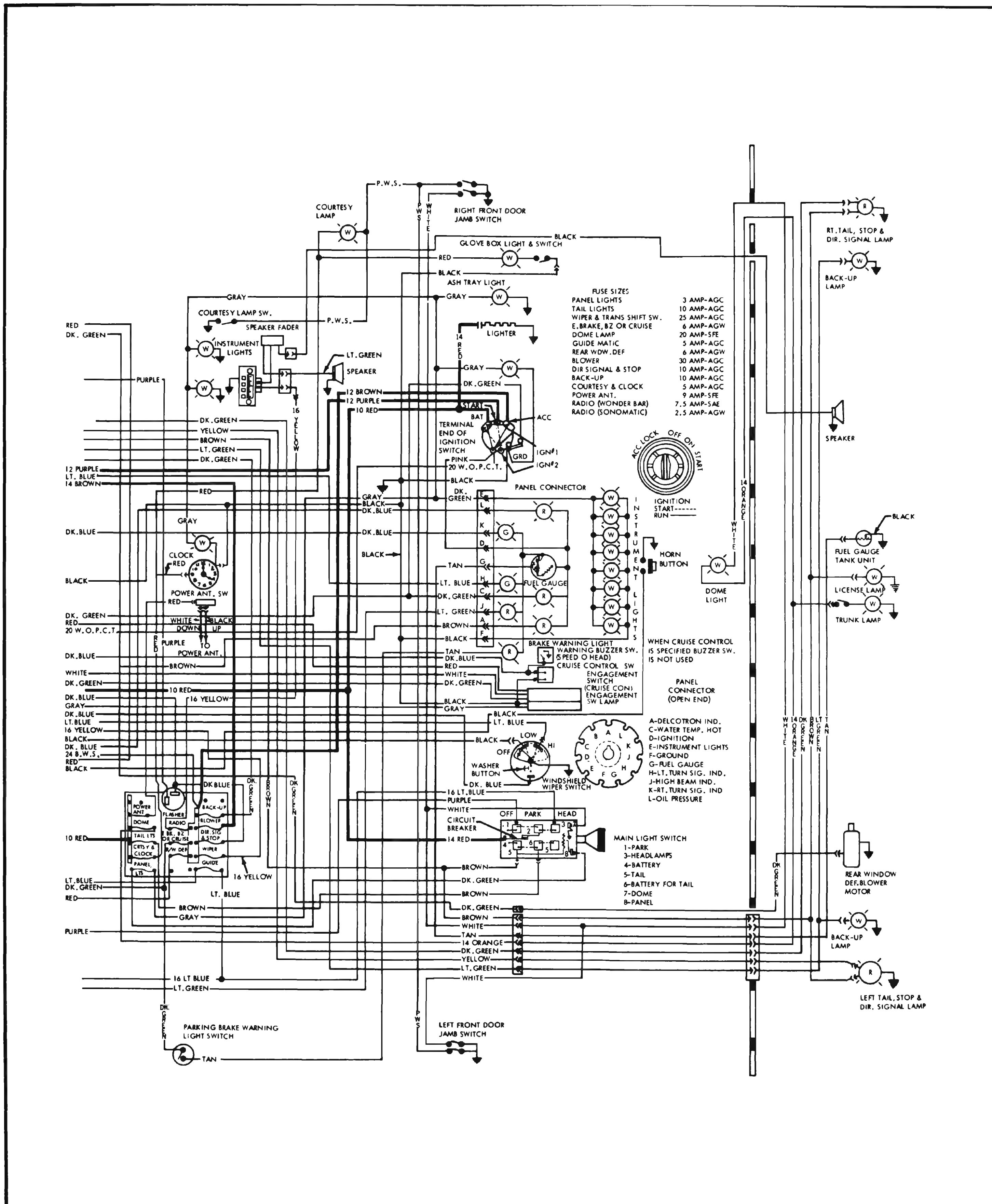


Figure 10-168—Chassis Wiring Diagram—Rear Half 4400 Series

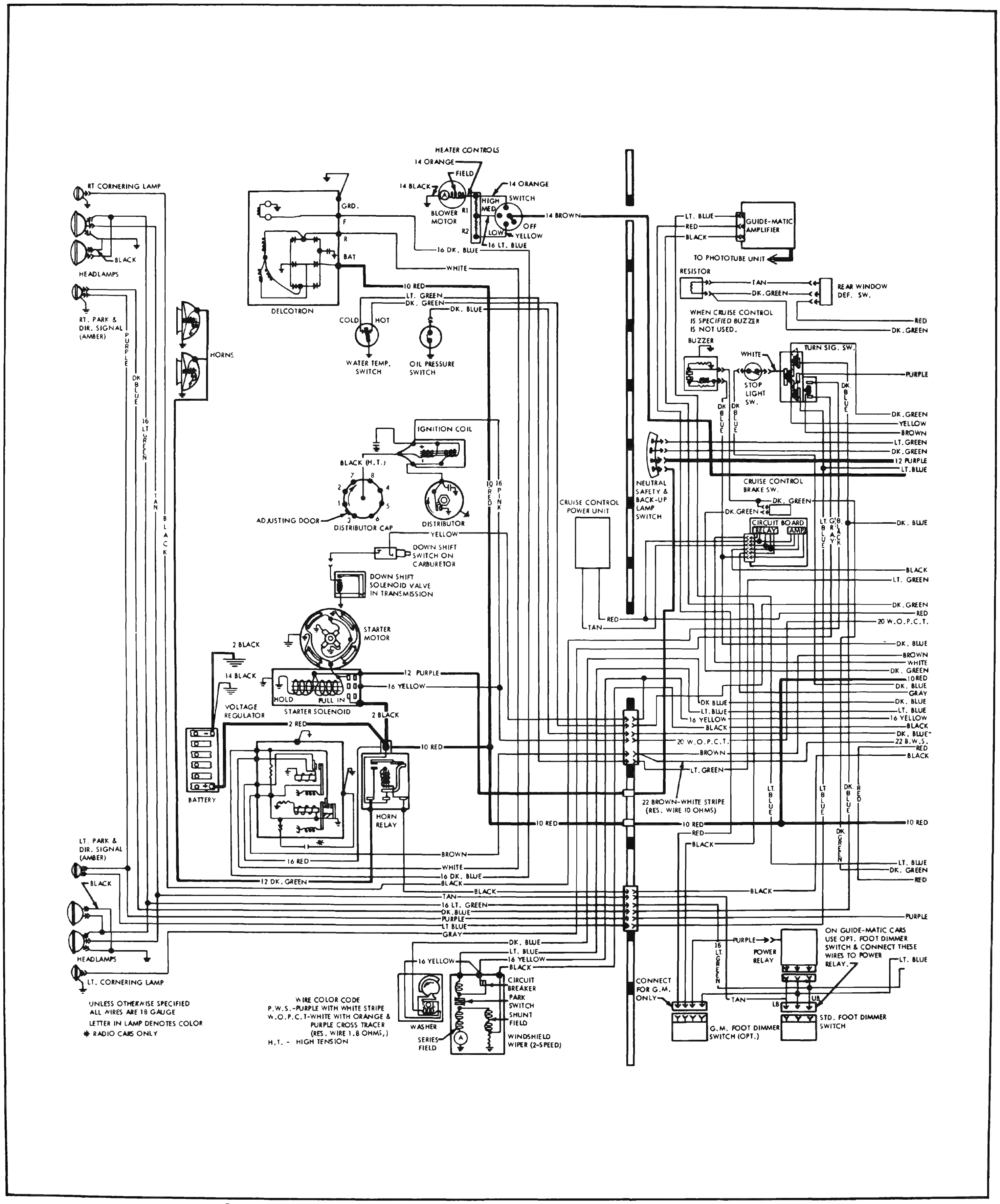


Figure 10-169—Chassis Wiring Diagram—Front Half 46-4800 Series

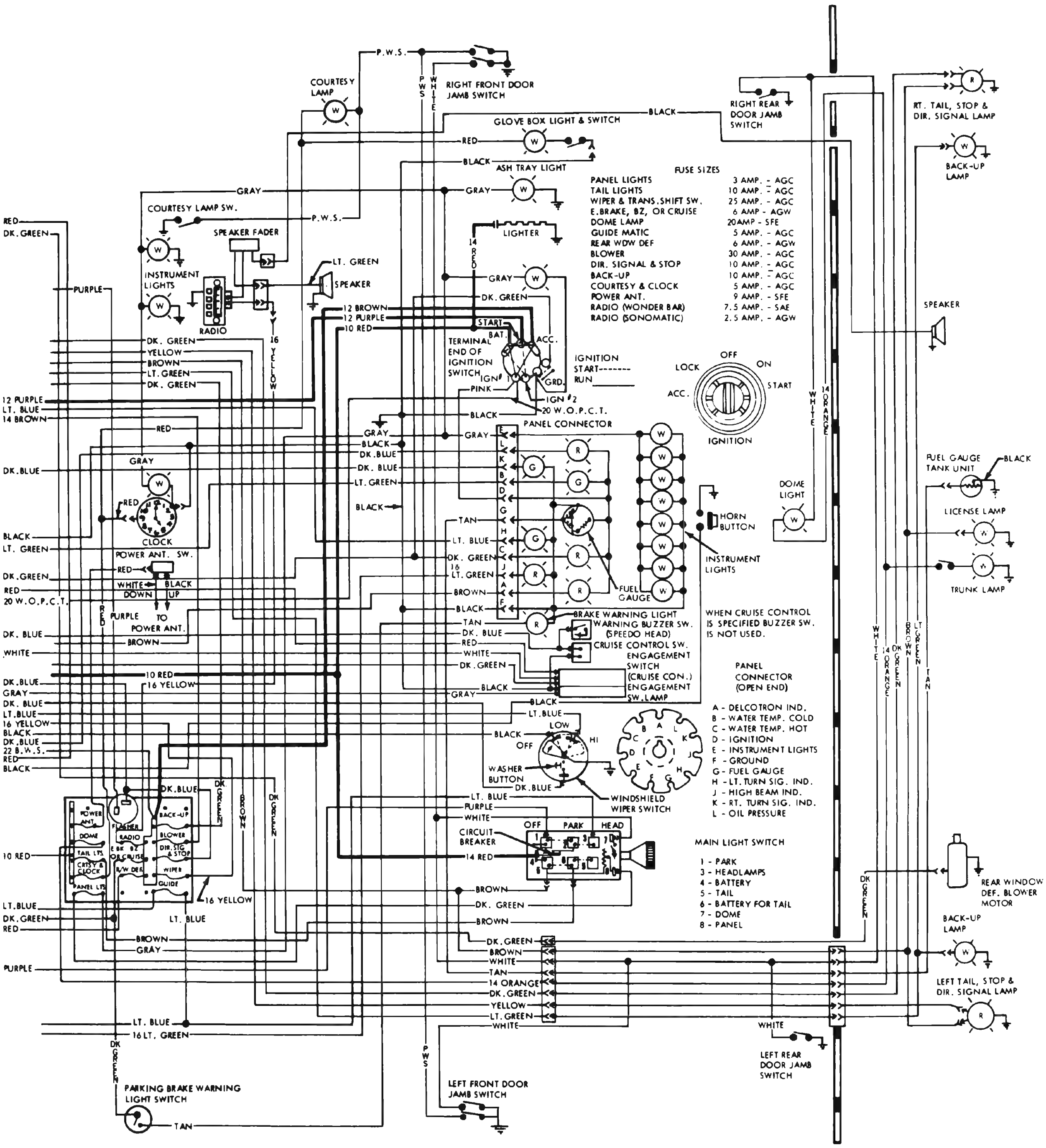


Figure 10-170—Chassis Wiring Diagram—Rear Half 46-4800 Series

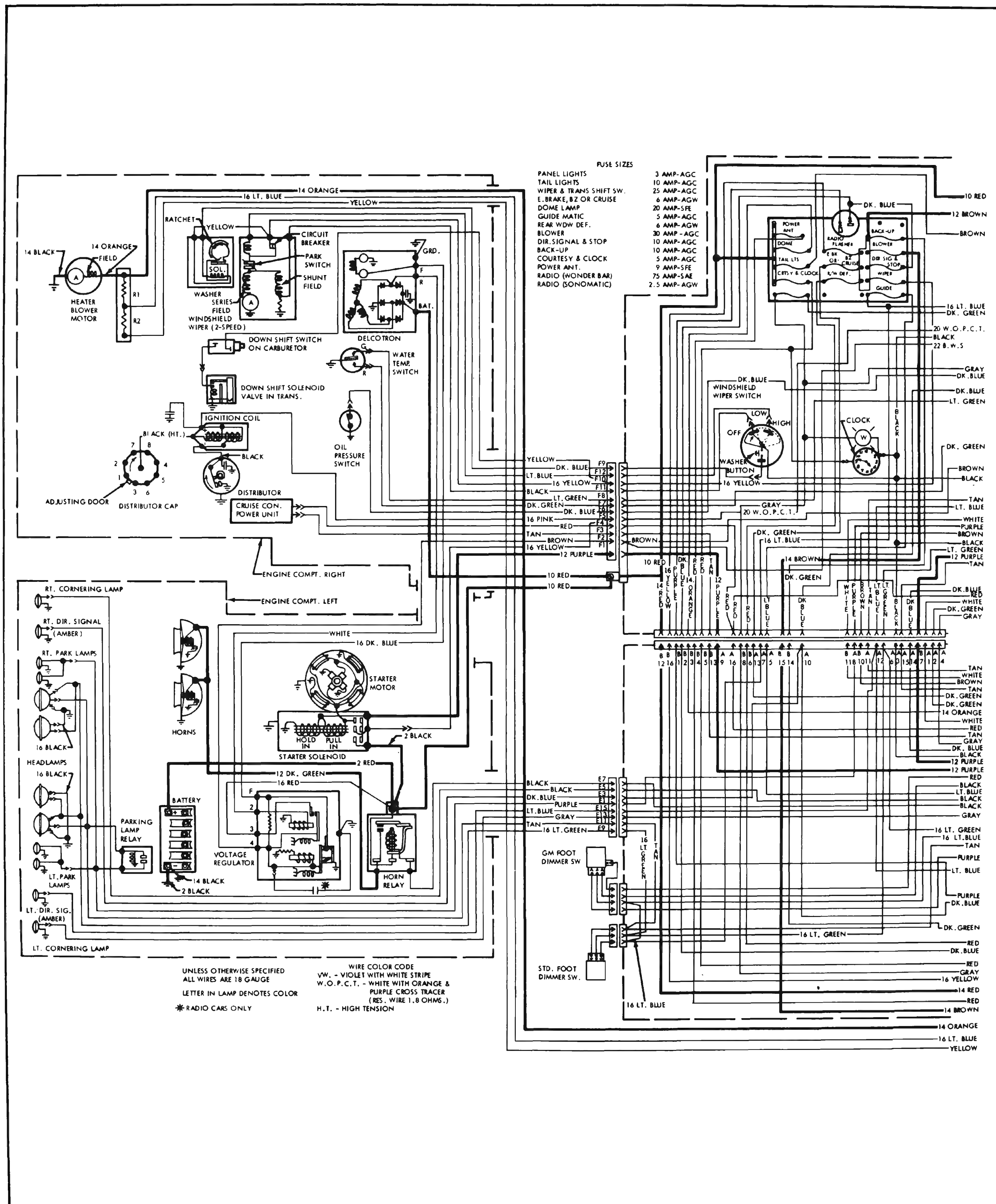


Figure 10-171—Chassis Wiring Diagram—Front Half 4700 Series

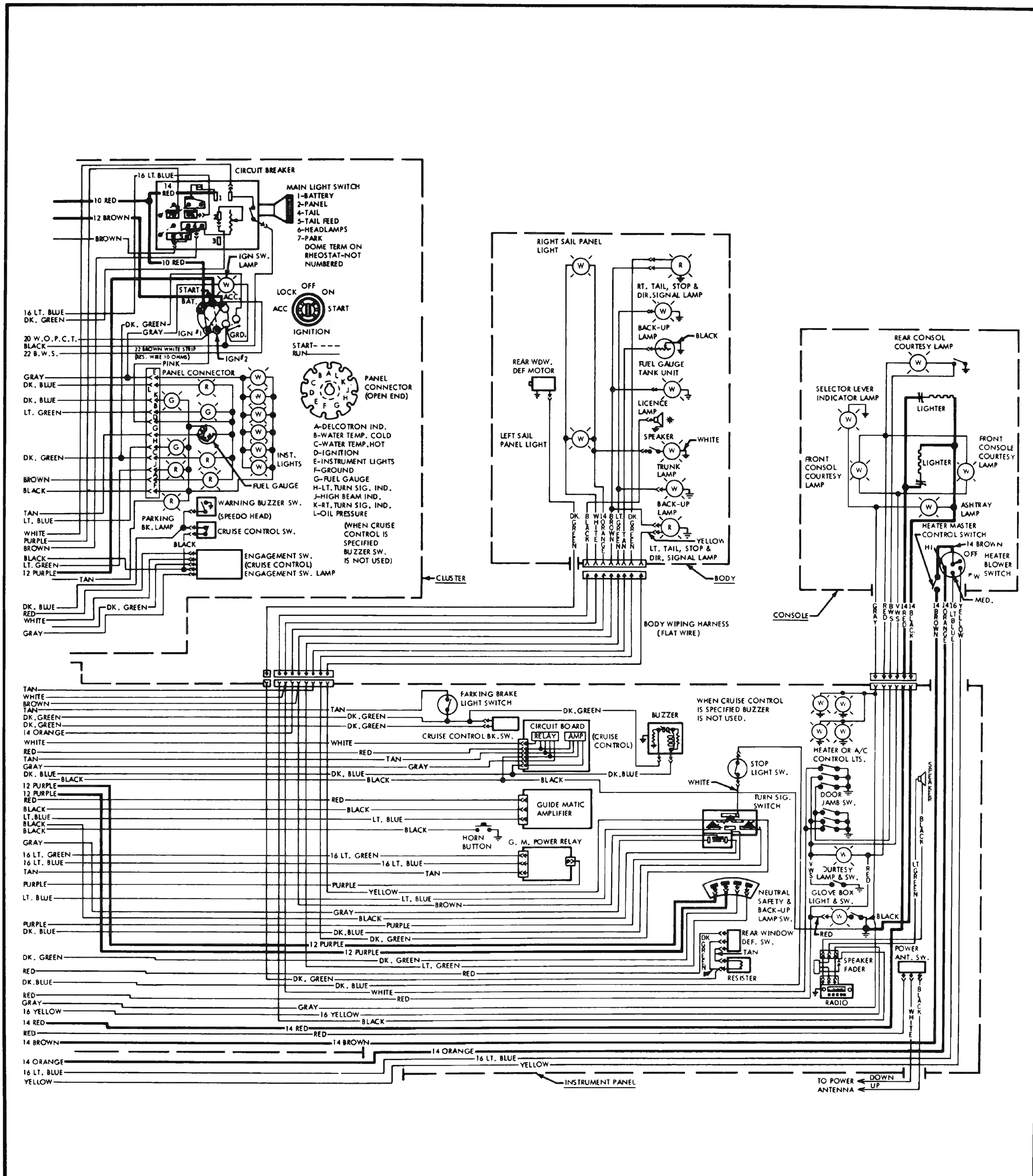


Figure 10-172—Chassis Wiring Diagram—Rear Half 4700 Series

GROUP 11
ACCESSORIES

SECTIONS IN GROUP 11

SECTION 11-A
RADIO AND ANTENNA

CONTENTS OF SECTION 11-A

11-1 BUICK RADIO DESCRIPTION AND OPERATING INSTRUCTIONS

a. Description

The Sonomatic and the Wonderbar Radios (see Figures 1-1 and 11-2) are available as optional equipment.

The Buick Sonomatic and Wonderbar radio installation consists of a receiver with separate speaker mounted at the center of the instrument panel on 4400, 4600, 4700 and 4800 Series. All speakers (including optional rear speakers on 4400, 4600, 4700 and 4800 cars) have an impedance of 10 ohms. When replacing a speaker, the replacement speaker must have the same impedance for satisfactory results.

The Sonomatic and Wonderbar radios are transistor radios which play immediately when turned on. Each radio has five push buttons (see Figures 11-1 and 11-2) for push-tuning of five pre-selected stations. In addition to the push buttons, a control knob permits manual selection of other stations.

The Wonderbar radio receiver also contains an automatic signal-seeking tuner by which the operator can change stations by merely depressing the selector bar on the receiver, or the foot control switch on the floor (see Figures 11-2, 11-3 and 11-4). The signal seeking tuner (Wonderbar radio only) sweeps the broadcast band from low to high frequency until a signal of sufficient strength is found. The tuning mechanism is driven by a spring loaded mechanical motor which is stopped on station by a triggering circuit actuated by voltage developed from the incoming signal. The number of stations on which the tuner will stop can be regulated by use of sensitivity control on the receiver (see Figure 11-2).

Both radios use a sectional

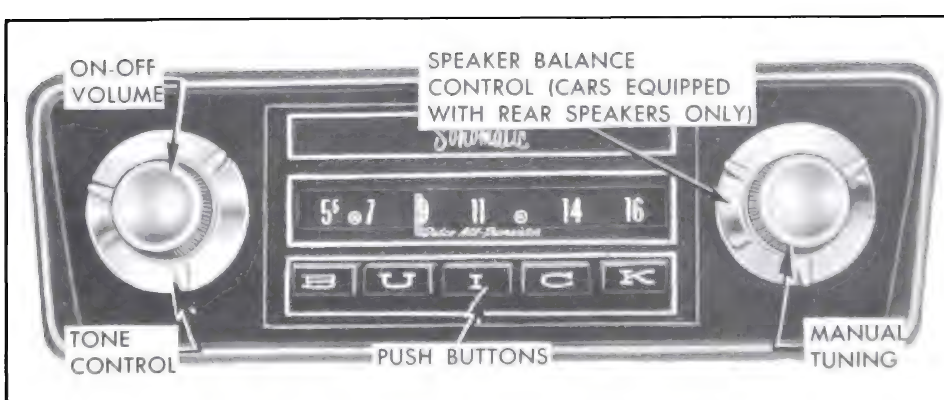


Figure 11-1—Sonomatic Radio Receiver Controls

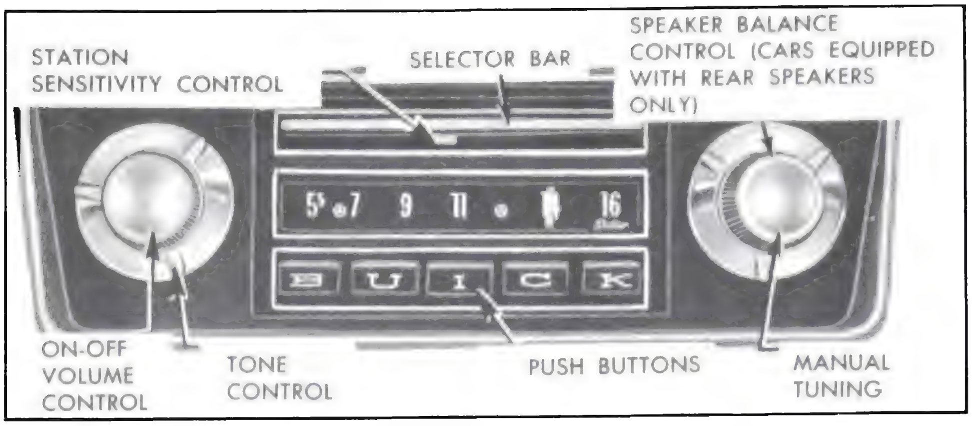


Figure 11-2—Wonderbar Radio Receiver Controls

manual or electric antenna mounted on the right front fender.

The manual antenna, which may be extended and retracted by hand, is standard equipment. The electrically operated antenna is available as optional equipment. In the electric antenna, a motor drives a nylon reed attached to the upper section of the antenna. A 3-position switch on the accessory panel above the radio controls the antenna motor, which will run in either direction. Pushing the switch to the front lowers the antenna, and pulling to the rear raises the antenna. When the switch is released, it returns to center off position.

CAUTION: Never attempt to force an electric antenna up or down by hand. This will cause permanent damage to the operating mechanism.

Radio noise interference is reduced by use of noise suppressor capacitors (see Figure 11-5) and also the inherent resistance of the wiring. The built-in resistance of each spark plug wire approximates 4,000 ohms per foot.

The ignition coil noise suppressor capacitor (0.3 MF) is mounted on the coil bracket and the lead is connected to the positive battery (+) terminal of ignition coil. If this polarity is not observed, excessive pitting of distributor contact points will result. The voltage regulator and delcotron noise suppressors are both rated at 0.5 MF and each is mounted on the exterior of their respective units.

A static collector is installed in each front wheel hub cup. For good results the cup and the center of steering knuckle spindle must be clean and free from grease. The center of static collector is made of self-lubricating material. In addition to the items mentioned above, bond or ground straps are connected between the cowl and the rear corners of the engine.

b. Switch, Volume, and Tone Control Operation

Clockwise rotation of the switch knob to the left of dial, turns the radio on, and further rotation increases the volume.

High fidelity (true tone) is provided when the tone control knob, behind the switch knob, is at the mid-position of the tone control range. A detent in the circuit provides a method of quick location of this position. Rotation clockwise of the tone control knob will diminish bass tones. Rotation counterclockwise will diminish treble tones.

The rear speaker for the 4400, 4600, 4700 and 4800 Series may be optionally installed at the factory or by the dealer. When the rear speaker is installed, the inner knob located behind the radio manual tuning knob, serves as the speaker balance control (see Figures 11-1 and 11-2).

The clockwise rotation of the control turns on the rear speaker only, the midway position blends front and rear speakers together, and the counterclockwise position turns on the front speaker only. After the volume has been set by the radio volume control, it will remain constant regardless of the position of the rear speaker control.

c. Push Button Tuning Operation—Wonderbar or Sonomatic

To tune in the station for which the push button is set, simply push the button in as far as possible. The button will move easily at the start, then a slightly harder push is required to complete the travel. At end of button travel the tuner will rest at the station for which the button has previously been set as described in paragraph 11-4 (b).

d. Selective Tuning Operation—Wonderbar Radio

NOTE: To insure adequate sensitivity for selective tuning of the Wonderbar radio it is best to have antenna extended at least half way.

With the radio turned on and warmed-up, selective tuning of available stations is accomplished by depressing either the selector bar above the dial (Figure 11-2), or the foot control switch left of the brake pedal on the floor (Figures 11-3 and 11-4).

When the bar or foot switch is fully depressed and released the tuner will automatically move to the right and stop accurately tuned, as it reaches the next station having adequate strength to stop it. The tuner will stop at

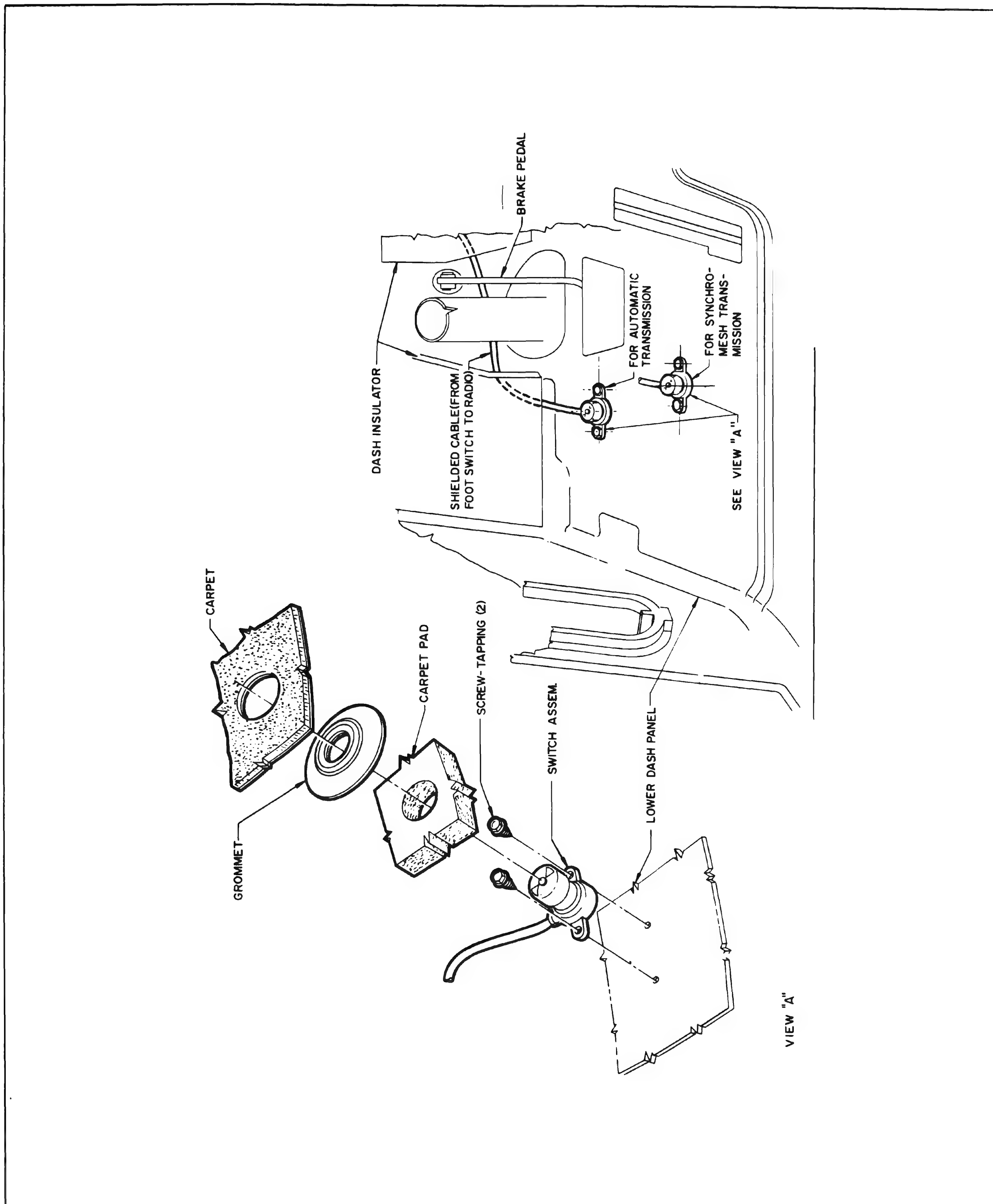


Figure 11-3—Wonderbar Radio Foot Switch and Cable Location - 4400, 4600 and 4800 Series

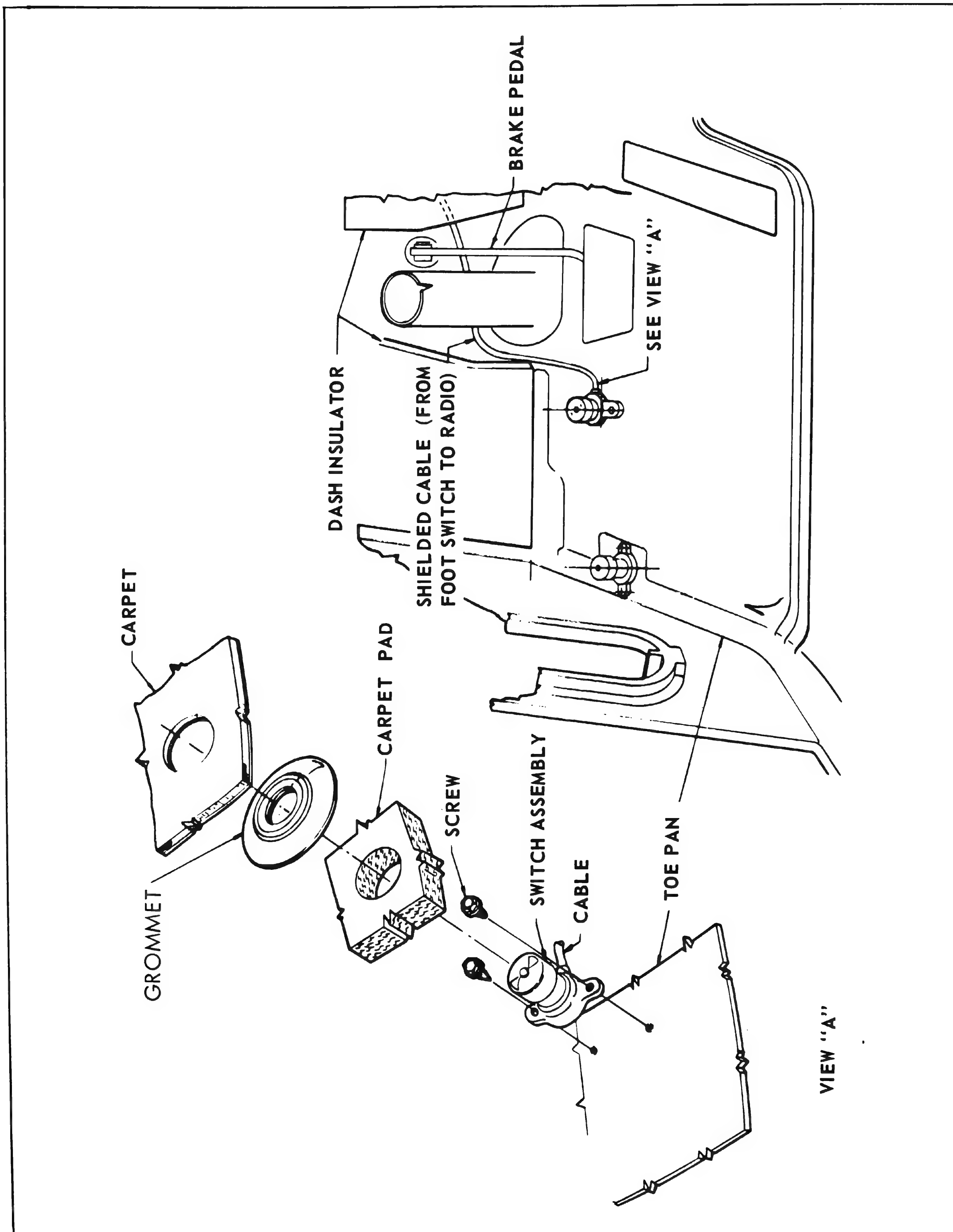


Figure 11-4—Wonderbar Foot Switch and Cable Location - 4700 Series

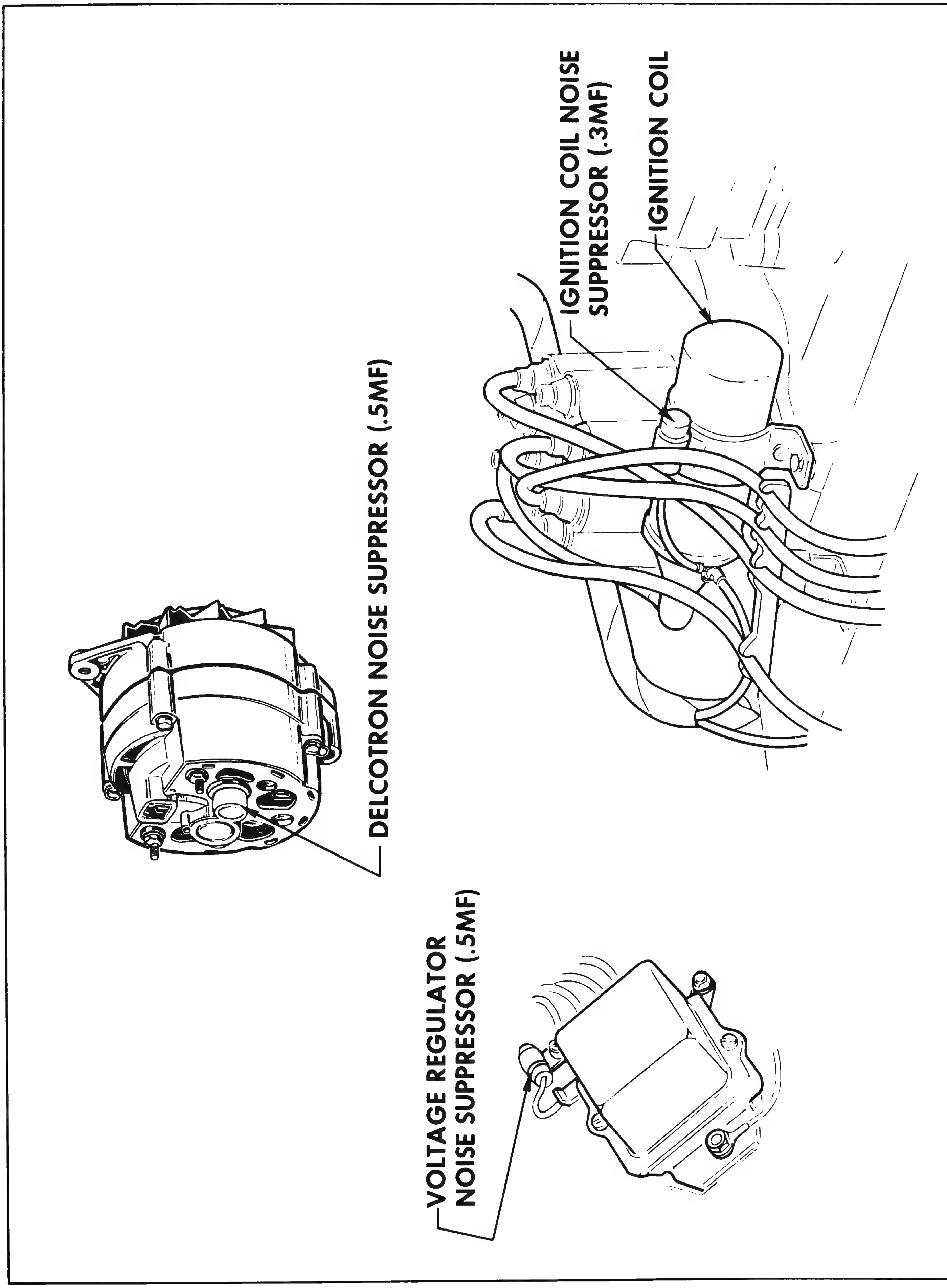


Figure 11-5—Noise Suppressors

a station having adequate strength even though the volume control is not turned up high enough for the station to be audible.

When the tuner reaches the right end of the dial it flies back to the left end and again starts moving to the right until it again reaches a station having sufficient strength to stop it. By holding the selector bar or foot control switch down, unwanted stations or areas of the dial can be quickly passed over.

The number of stations on which the tuner will stop in selective tuning is regulated by manual setting of the sensitivity control (see Figure 11-2). This is a step control having three positions. This control is in the circuit only while the tuner is seeking and does not affect the "on station" sensitivity of the receiver.

Moving the sensitivity control lever to the right position increases the number of stations that can be received. Moving the control lever to the left decreases the number of stations by eliminating those having weak signal strength in the area where the car is located. In the full left position of the control, the tuner will usually stop only on strong local stations.

If the Wonderbar tuner is operated in certain shielded localities or around buildings where an adequate signal is not available, the tuner may automatically search the band from one end to the other without stopping. The sensitivity control should be moved to the full right position and the antenna fully extended when this condition is encountered, or manual tuning should be used.

e. Manual Tuning Operation

The manual tuning knob is to the right of the dial. On the Sonomatic radio, this knob may be used to tune in stations other than those for which the push buttons are set; it is also used when tuning to set the buttons for selected stations. On the Wonderbar radio, the tuning knob may also be used to tune in stations that are too weak to stop the electronic signal seeking section of the tuner.

When tuning manually, and particularly when setting a station on one of the push buttons, careful adjustment of the tuning knob is essential in good radio reception.

On push button selection, if the program sounds unnatural or distorted, it is probably caused by improper tuning and can be corrected by adjusting the tuning knob slightly. Since the low notes are more affected by improper tuning than the high ones, it is desirable to tune the set to a point where the low notes are heard best and high notes are clear and undistorted. This point may be most readily found by listening to the background noise and tuning for the lowest volume and pitch of this noise. Turning the control knob back and forth until the station is almost lost on either side will enable the operator to hear the difference in reception and select the intermediate position giving best results.

f. AM-FM Radio

This radio is identical to the Sonomatic or Wonderbar radios as far as the operation of the on-off and volume control, tone control, manual tuning control and push buttons are concerned. The AM-FM Selector bar is located directly above the dial face. Movement of the bar to the left exposes the letters "FM" and switches the radio to FM mode of operation. Movement of the bar to the right provides AM radio operation. An automatic frequency control circuit is incorporated in the radio and acts to automatically adjust the receiver to select the strongest of the incoming signals if the tuner is adjusted to a point where more than one incoming signal is being received. In general the FM mode of operation will provide greater reception fidelity and freedom from static and other atmospheric disturbances. The FM signal is very susceptible to interference due to tall buildings, hills, etc. In these cases reception may be partially or totally blanked out until the car has moved around or away from the interfering object. In fringe areas where radio reception (FM) is weakest, the station sound may flutter or vary up and down and interference from passing cars may be picked up by your FM radio. In these cases the receiver should be readjusted to a stronger station.

Servicing of this radio is identical to Sonomatic or Wonderbar radios and the following instructions contained herein are also applicable to the AM-FM radio.

11-2 RADIO TROUBLE DIAGNOSIS— ON CAR

The trouble diagnosis information in this paragraph is of elementary nature. It is intended as an aid in locating minor faults which can be corrected without a specialized knowledge of radio and without special radio test equipment. The following information applies to the Sonomatic as well as the Wonderbar radio. If the suggestions given here do not affect a correction, further testing should be done only by a radio technician.

a. Radio is Inoperative or "Dead"

1. Turn radio on. The dial should light and a "thump" should be heard from the speaker.

(a) If "thump" is heard, go to check 2 for antenna.

(b) If no "thump" is heard, check fuse.

(1) If fuse is bad, replace and try radio again. Race engine, if the fuse blows again, remove the radio and speaker for repair by a radio technician.

(2) If fuse is OK, check to see that the speaker to receiver interconnecting cable is connected securely. If there is still no "thump" as the radio is turned on, remove receiver and speaker for repair.

2. Check the antenna by substituting with a known good one, and hold substitute antenna out car window. If radio is still dead, remove the receiver and speaker for repair.

b. Radio is "Weak"

1. Check to see if antenna trimmer is peaked.

(a) Position antenna at a height of 28 inches.

(b) Tune radio to weak station between 600 and 1000 KC on the dial and turn volume control to maximum.

(c) Insert a screwdriver in antenna trimmer screw and rotate screw to achieve maximum volume (see Figures 11-6 and 11-7).

(d) If the antenna trimmer does not have a definite peak, check for defective antenna by substituting a known good antenna as in Step "a", 2 above.

2. Be sure the speaker connection is plugged in securely.

3. If the radio is still weak, remove the receiver and speaker assembly for repair.

c. Radio is "Noisy"

1. Radio is "noisy" all the time:

(a) Check for noisy antenna by striking rod with hand. If antenna is noisy, replace.

(b) If antenna is OK, remove receiver and speaker for repair.

2. Radio is noisy only when jarred:

(a) Check antenna as in Step "c" (1).

(b) Check speaker connections. If OK, remove receiver and speaker for repair.

3. Radio is noisy when engine is running:

(a) Check all noise suppressors.

(1) Check that spark plugs are firmly seated and connected at each end. Also check that wires are the original resistance type (approximately 4000 ohms per foot).

(2) Substitute suppressor capacitors on delcotron, regulator, and ignition coil with known good ones.

(b) Check that antenna is mounted securely, grounding the antenna base to the fender. (Antenna lead-in wire is shielded and the shield should have good ground connection at the receiver and antenna base.)

(c) Check for other car wiring passing too close to receiver case.

(d) Check ground wire between rear corner of engine and cowl.

(e) If engine noise is still present, take radio to a radio technician with full story on the complaint.

4. Radio is noisy when car equipment is operated such as directional lights, power seat or power windows:

(a) Check for defective antenna lead in wire or loose antenna mounting as in Step 3 (b).

5. Radio is noisy only on dry days when car is moving:

(a) Wheel and tire static will occur only during dry weather. To check if noise is wheel static or tire static, drive car down highway until noise is noticed. Touch the brake - if noise disappears, it's wheel static; if noise persists, it's tire static.

(1) Wheel static is eliminated by installation of static collectors in the front wheels. It is important to make sure the button on the end of the spiral collector rides evenly on the spindle. Grease and dirt can cause poor contact between static collector and the cap, which could cause wheel static, even with the collectors installed.

(2) Tire static is eliminated by injecting graphite "tire static" powder in all five tires. Either a special gun or a plastic squeeze bottle can be used to insert powder.

d. Electric Antenna Operates Improperly

1. If operation of antenna to full up or full down position is slower than 12 seconds, check for dirty, corroded or bent antenna sections. Antenna sections must be kept clean and straight. The sections may occasionally be sparingly oiled on the surface with light machine oil.

2. If antenna sections are clean and straight and operation is still faulty, check all wiring including ground connections to cowl; also check for defective control switch.

3. If cause of faulty operation has not been found, remove antenna and check for defective tube and nylon assembly or defective motor.

e. Electric Antenna Does Not Operate

1. If antenna motor does not operate, check fuse and all wiring including ground connection. Also check for defective control switch.

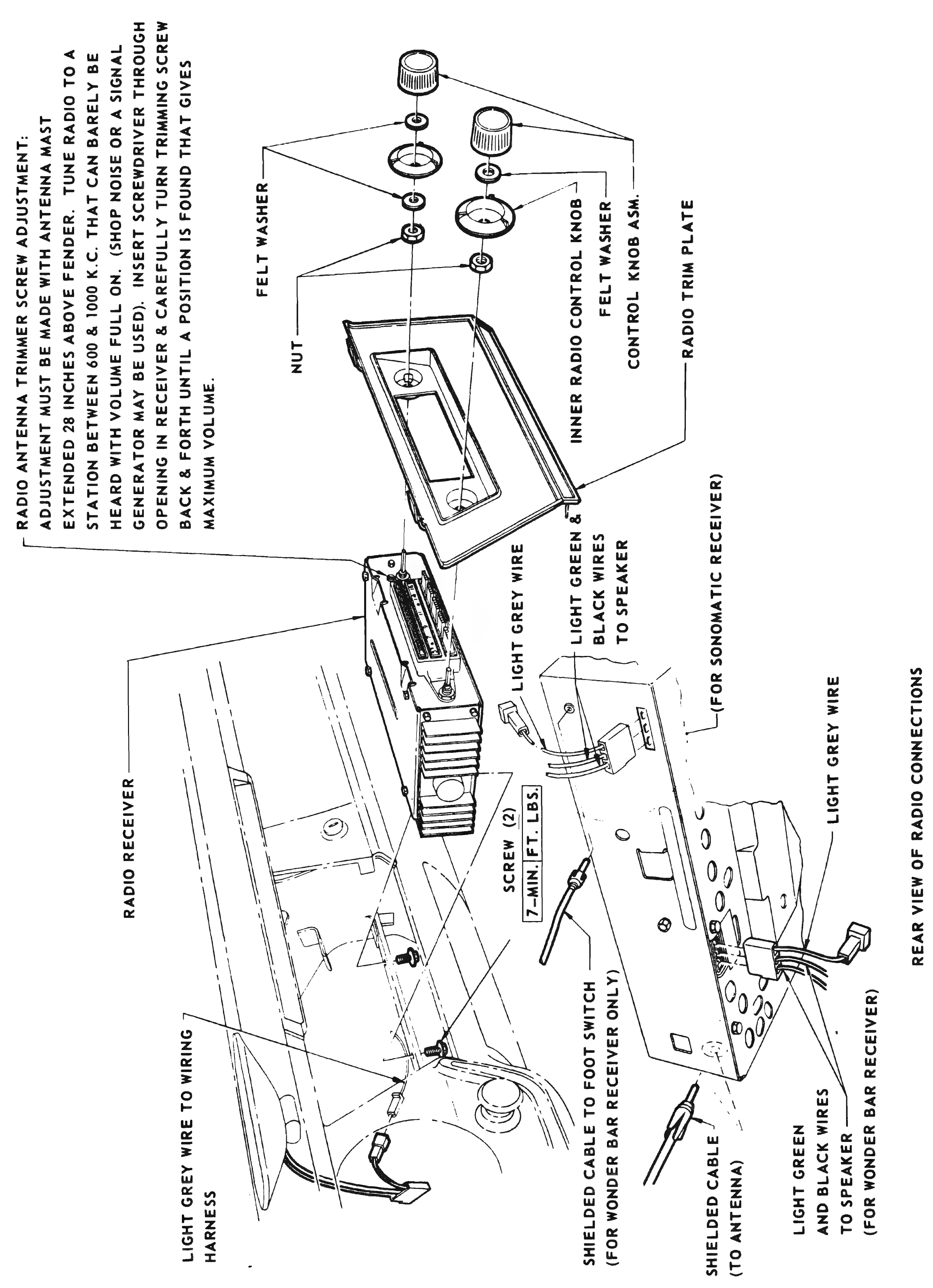


Figure 11-6—Radio Receiver Installation - 4400, 4600 and 4800 Series

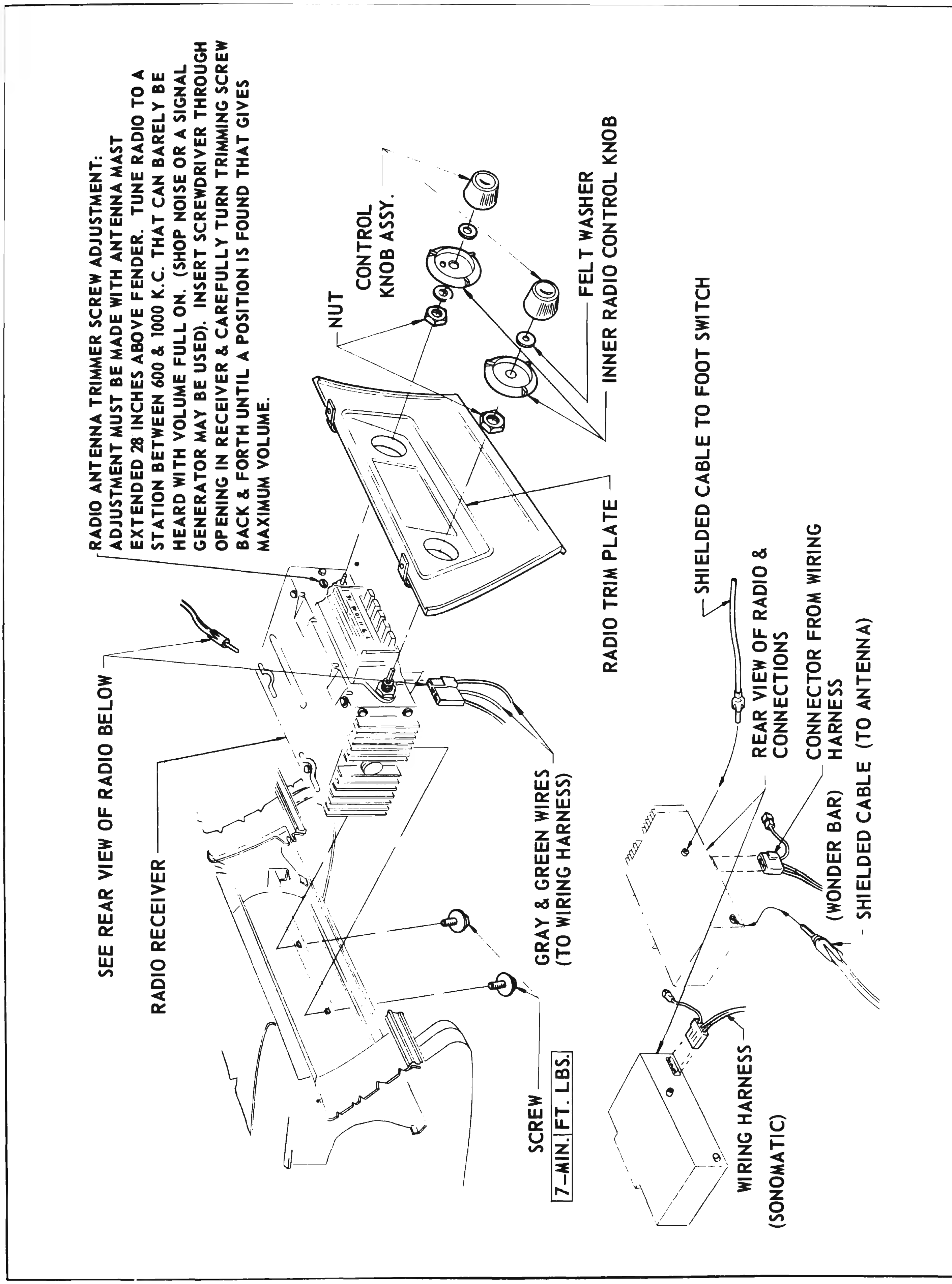


Figure 11-7—Radio Receiver Installation - 4700 Series

2. If motor still does not operate, or new fuse blows out, either the motor or its leads are faulty and must be repaired or replaced.

3. When motor operates, but antenna will not raise or lower (as evidenced by clicking sound in antenna clutch) check for dirty, corroded or bent antenna sections.

4. If antenna still fails to operate it will be necessary to remove antenna from car and disassemble for inspection and service.

11-3 SERVICING RADIO COMPONENTS

a. Removal and Installation of Radio (4400, 4600 & 4800)

REMOVAL

1. Remove four screws from ash receiver assembly, disconnect lamp socket from receiver assembly and take out ash receiver assembly.

2. If car is air conditioned, remove two screws securing center air outlet assembly to radio trim plate and lift off outlet assembly, and also center outlet duct located directly under outlet assembly.

3. Remove two nuts holding bottom corners of radio trim plate (nuts are on underside of trim plate) to dash.

4. Remove two screws holding underside of receiver to cross support (see Figure 11-6) and partially withdraw radio trim plate and receiver.

5. Remove all lead connectors attached to receiver and complete removal of receiver and trim plate.

6. Further disassembly of trim plate from receiver will be obvious on inspection.

INSTALLATION

7. Install receiver reverse of removal and perform antenna trimmer adjustment (ref. subpar. 11-4, "a").

b. Removal and Installation of Radio (4700)

REMOVAL

1. Remove two screws from center console front trim plate assembly (see Figure 11-8) and partially lift up front trim plate.

2. Disconnect lamp socket and lighter lead connector and complete removal of front trim plate.

3. If car is air conditioned, remove two screws holding air conditioner center outlet assembly to radio trim plate (see Figure 11-7) and lift off center outlet assembly, and also center outlet duct.

4. Remove four screws and lower air conditioner control assembly (see Figure 11-8).

5. Remove two screws from lower corners of radio trim plate and two screws securing underside of receiver to cross support, and partially withdraw receiver and radio trim plate.

6. Remove all lead connectors attached to receiver and complete removal of receiver and radio trim plate.

7. Further disassembly of radio trim plate from receiver will be obvious upon inspection.

INSTALLATION

8. Install receiver reverse of removal and perform antenna trimmer adjustment (ref. subpar. 11-4, "a").

c. Removal and Installation of Manual and Electric Antenna

REMOVAL

1. Turn front wheels full right and remove antenna access hole cover from right fender outer skirt (see Figures 11-9 and 11-10).

2. On 4400, 4600 and 4800 Series remove antenna nut, adapter, and pad from top of fender. On 4700 Series loosen pinch clamp around lower portion of adapter assembly.

3. Disconnect lead-in wire from antenna. On electric antenna also disconnect motor wire connector.

4. Remove antenna assembly through access hole in skirt.

INSTALLATION

5. Position antenna rod toward rear of car 1 to 2 degrees and install antenna reverse of removal procedure.

NOTE: On 4700 Series, be sure that the adapter assembly fits into the slots of the antenna assembly. Be sure grounding tab is placed between the adapter assembly and pinch clamp (see Figure 11-10).

IMPORTANT: The Buick antennas are matched to the receiver within the range of the trimmer adjustment. Use of other than authorized replacement antennas is not recommended.

d. Disassembly and Reassembly of Electric Antenna

IMPORTANT: Before work is started on the antenna, determine if the antenna is in the warranty period which is 24,000 miles or two years, whichever occurs first. If the antenna is in warranty do not attempt service on components of the antenna drive (see Figure 11-13) as it will void the warranty.

DISASSEMBLY OF BODY AND UPPER INSULATOR

1. Remove the 3 screws holding the body and upper insulator assembly to support tube (see Figure 11-13).

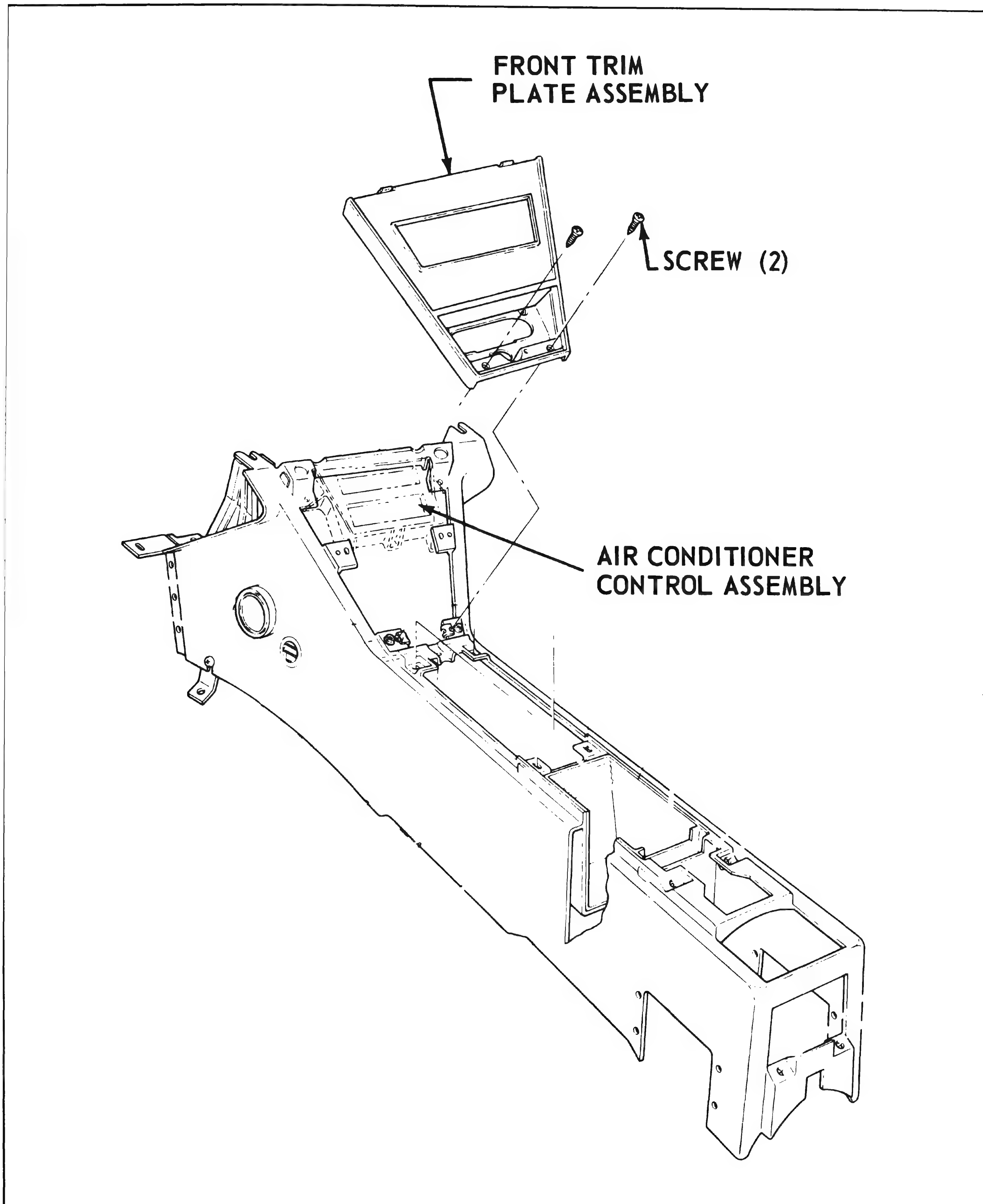


Figure 11-8—Center Console Front Trim Plate and Air Conditioner Control Assembly - 4700 Series

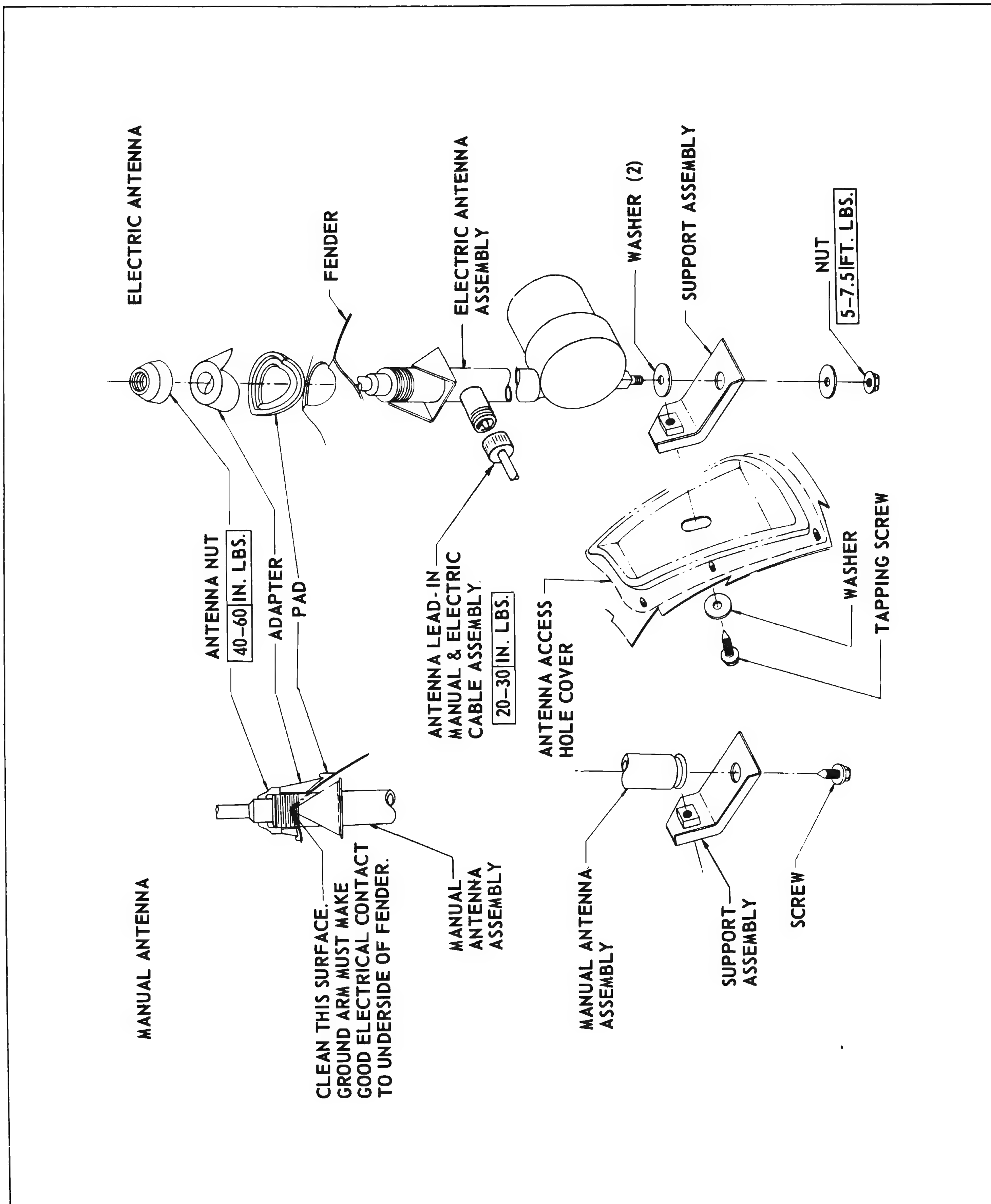


Figure 11-9—Manual and Electric Antenna Installation - 4400, 4600 and 4800 Series

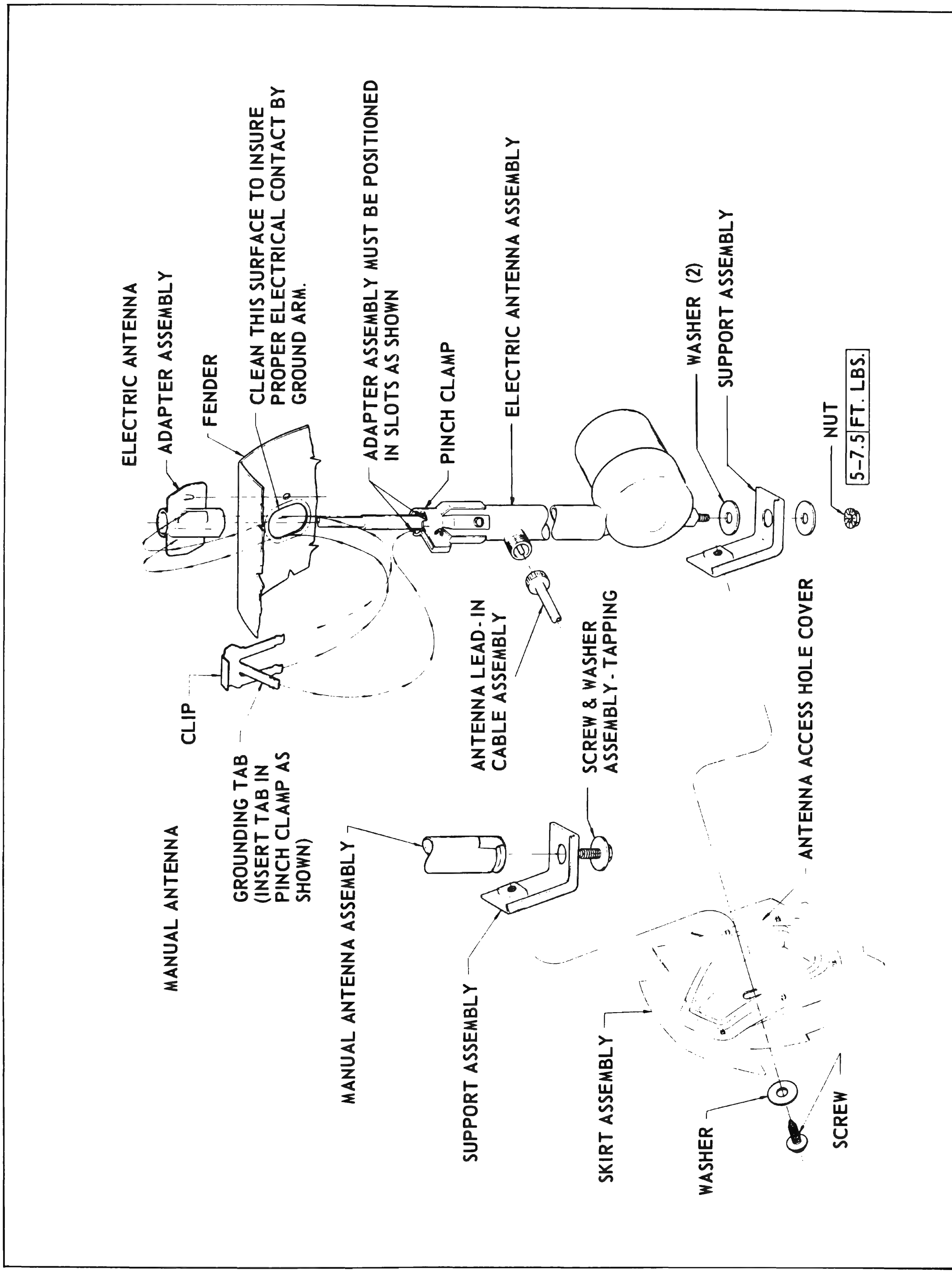


Figure 11-10—Manual and Electric Antenna Installation - 4700 Series

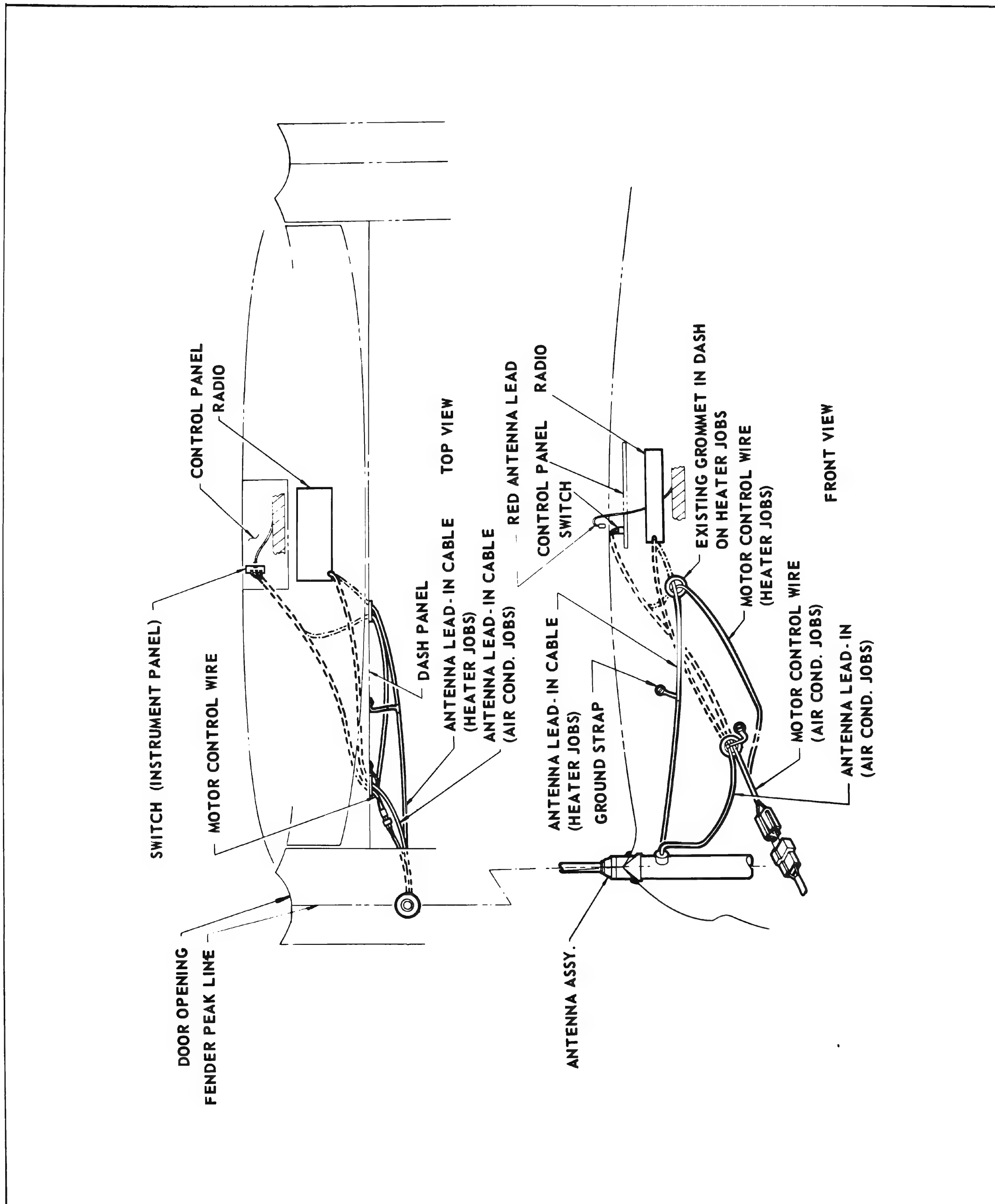


Figure 11-11—Antenna Lead-In Wire and Motor Control Wire - 4400, 4600 and 4800 Series

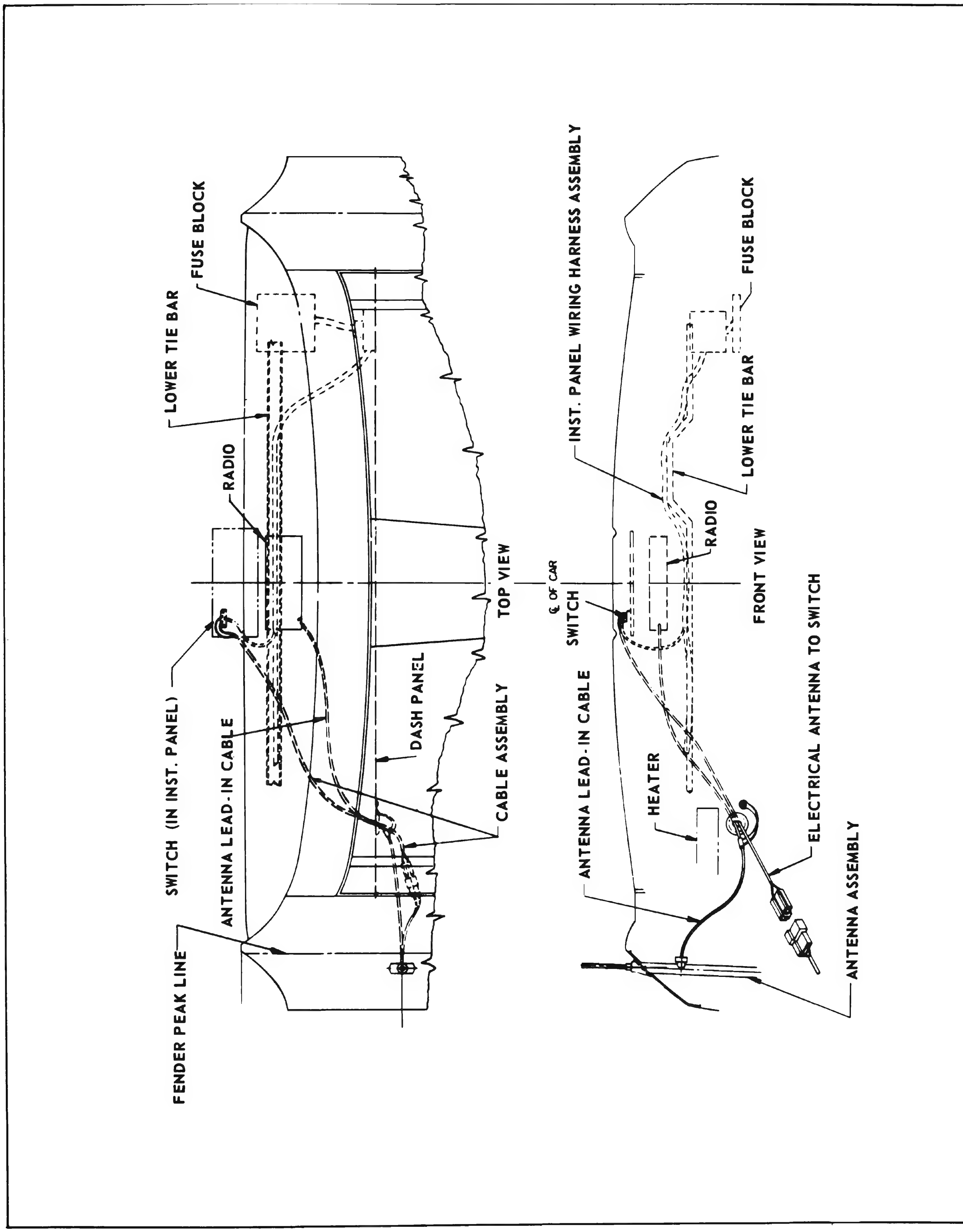


Figure 11-12—Antenna Lead-In Wire and Motor Control Wire - 4700 Series

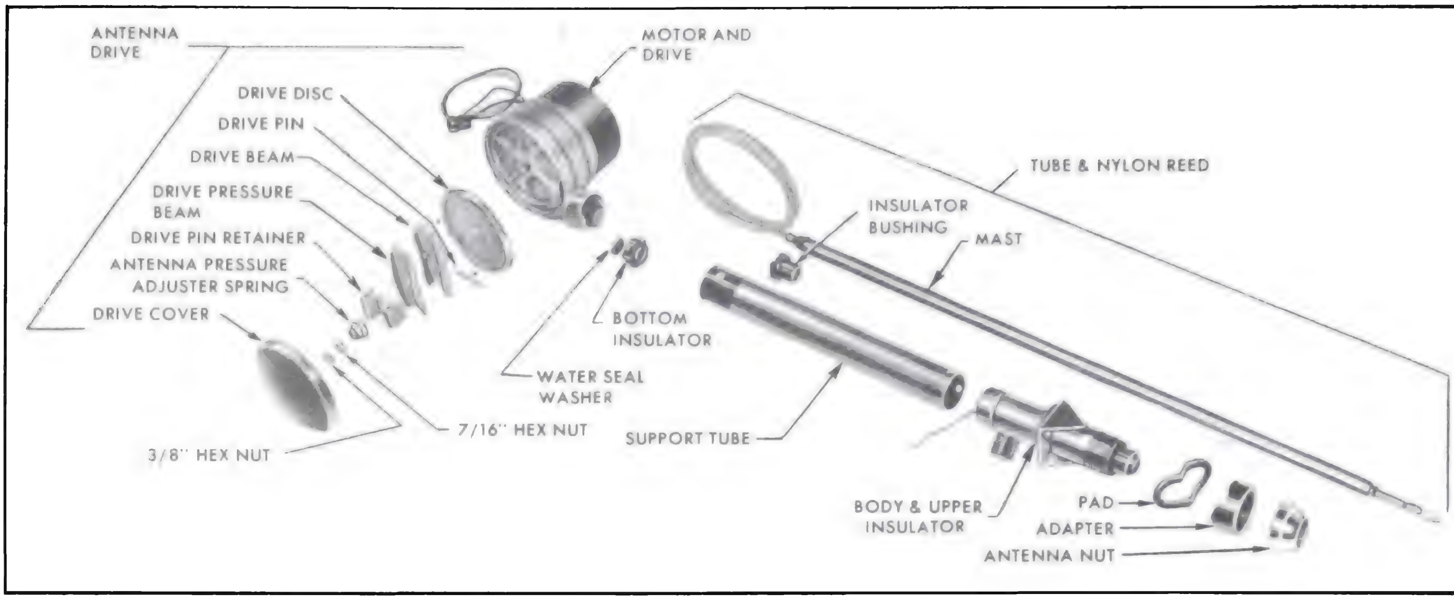


Figure 11-13—Electric Antenna (Exploded View) -4400, 4600 and 4800 Series

2. While applying a back and forth rotary motion, carefully pull the body upper insulator assembly out of the support tube and partially slide it over the 0.400 inch diameter section of the mast until the solder joint is accessible.

3. Unsolder hook-up wire from 0.400 inch diameter section of the mast (see Figure 11-14).

4. Complete removal of the body and upper insulator from the mast.

DISASSEMBLY OF SUPPORT TUBE AND MAST

5. Remove the 3 screws which hold the support tube to antenna drive.

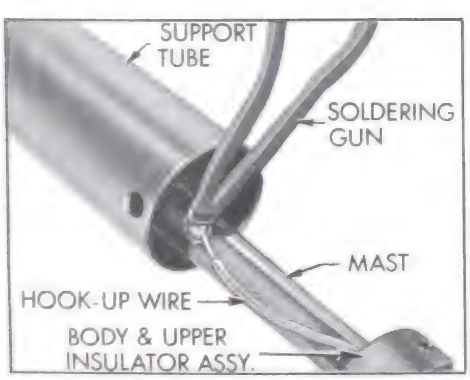


Figure 11-14—Hook-Up Wire to Mast Connection

6. Holding antenna drive in one hand and support tube in other hand, pull with a rotary motion until the support tube is removed.

7. Holding antenna drive in one hand and the mast in other hand, pull with a rocking motion, until the insulator bushing and mast are free from the tabular fitting of antenna drive (see Figure 11-15).

8. Apply 12 volts D.C. to the green wire of the antenna drive until the entire length of nylon reed has been expelled, and remove mast. Pull on the mast to keep the nylon taut.

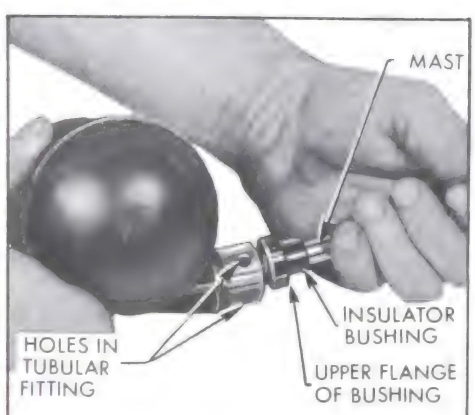


Figure 11-15—Removing and Installing Mast and Insulator Bushing

NOTE: If the antenna drive is inoperative, it will be necessary to manually remove the nylon reed. Place the assembly in a vise so that the normal plane of the nylon reed is parallel with the floor. Using both hands, pull on the 0.300 inch diameter section of the mast until the reed is completely removed.

9. Using a wire hook or long nose pliers remove bottom insulator and water seal washer from tubular fitting of antenna drive.

NOTE: IF THE ANTENNA IS IN WARRANTY DO NOT DISASSEMBLE BEYOND THIS POINT AS IT WILL VOID THE WARRANTY AGREEMENT.

DISASSEMBLY OF ANTENNA DRIVE (UNIT NOT IN WARRANTY)

If the antenna drive is no longer covered by the manufacturer's warranty and it is necessary to repair the antenna drive, proceed as follows:

10. Remove drive cover.

11. Hold the 7/16" hex nut on the output gear assembly shaft, remove the 3/8" hex nut (see Figure 11-16).

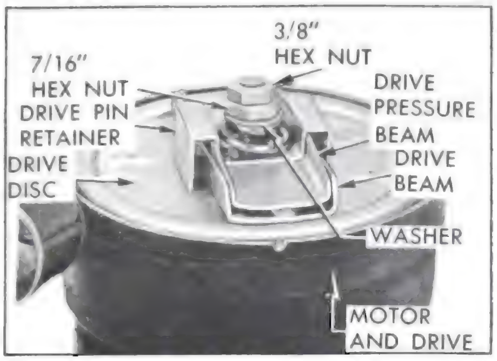


Figure 11-16—Antenna Drive (Cover Removed)

12. Remove the 7/16" hex nut and washer.

13. Lift antenna pressure adjuster spring off shaft (see Figure 11-13).

NOTE: When removing any of the following parts, observe their locations and positions to facilitate reassembly.

14. Remove drive pin retainer.

15. Remove the drive pressure beam.

16. Slide the drive pin from hole in the shaft and take off drive beam.

NOTE: Do not lose the 2 steel balls in the holes at the ends of the drive beam.

17. Remove the 2 steel balls.

18. Remove the drive disc from the shaft.

NOTE: Exercise care not to bend the drive disc or burr the edges of the channel. If it is necessary to remove drive body from motor of motor drive unit to take out a broken nylon reed from storage cup, care must be used to prevent pinion gears (see Figure 11-17) from falling loose. If for any reason the gears fall out or have been removed, it will be necessary to realign them. This is done by positioning the right and left pinion gears so that the mark on each one points at the center of the pinion shaft of the drive gear which receives the motor pinion.

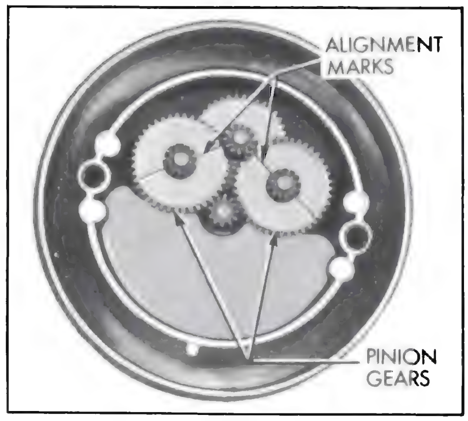


Figure 11-17—Alignment of Gears

REASSEMBLY OF ANTENNA DRIVE

Reassemble antenna drive components reverse of disassembly procedures. The following notes apply to assembly steps on which special emphasis is placed.

19. Reassemble the spring on the output gear assembly shaft with the largest diameter toward the drive pin retainer.

20. Screw on the 7/16" hex nut 1 full turn after it touches the spring.

NOTE: Do not reassemble the 3/8" hex nut on the shaft or snap the drive cover in place until antenna is adjusted.

REASSEMBLY OF MAST, SUPPORT TUBE, AND BODY AND UPPER INSULATOR

21. Thread nylon reed into antenna drive. Make sure that bottom insulator and water seal washer are in place and that the small diameter end of the bottom insulator is downward. Apply 12 volts D.C. to blue power lead to assist feeding operation. Keep nylon reed straight to avoid kinking.

NOTE: Position water seal washer and bottom insulator in the tubular fitting of antenna drive before the nylon reed completely disappears in drive assembly.

22. Push 0.400 inch diameter section of mast and insulator bushing into tubular fitting (see Figure 11-15). Make sure that the upper edge of insulator bushing flange is below the 3 holes in the tubular fitting of antenna drive.

23. Install support tube.

24. Slip body and upper insulator assembly over the 0.400 inch section of mast, but do not connect to support tube. Make sure that the free-end of the hook-up wire extends below the lower edge of the body and upper insulator assembly.

25. Solder the free-end of the hook-up wire to the 0.400 inch diameter section of the mast section, using rosin flux solder (see Figure 11-14).

26. Position and reassemble body and upper insulator to support tube.

27. Perform antenna adjustment procedure (ref. subpar. "e").

28. Reassemble 3/8" hex nut and drive cover onto antenna drive and make sure that the vent hole in the drive cover is at the top when the antenna is installed in the car.

29. Reseal the antenna drive with body sealer and make sure that neither the vent hole in the drive cover, nor the drain hole in the antenna drive is plugged.

e. Adjustment of Antenna

1. Remove the drive cover and 3/8 inch hex nut from the antenna drive.

2. Place antenna drive in a vise so that the center line of antenna drive is parallel to the bench top.

3. Using 12 volts D.C.—adjust mast tip approximately 6 inches from the extreme down position.

4. Connect one end of a wire securely to the mast just below the tip and the other end to a 25 lb.

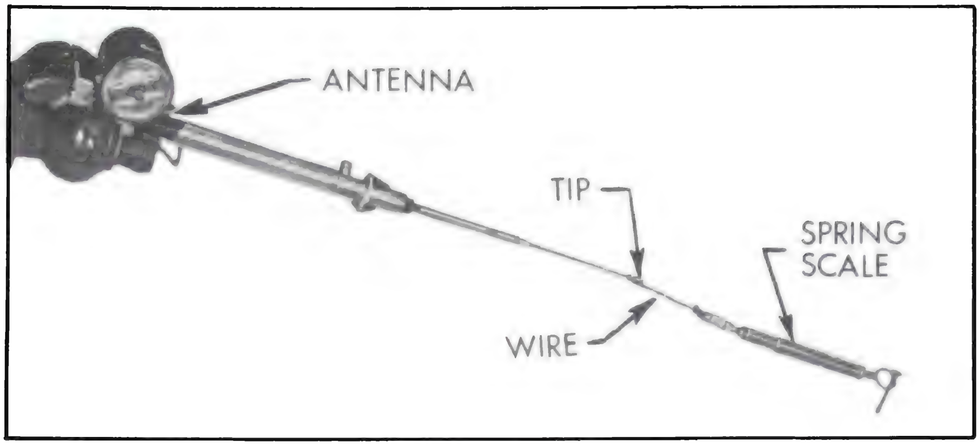


Figure 11-18—Antenna Adjusting Test

capacity spring scale. Secure the spring scale to the bench so that the center line of the scale is in line with that of the mast assembly (see Figure 11-18).

5. Attach the 12 volt D.C. power leads to the antenna drive housing and touch the other power lead to the blue (down) terminal to jog the antenna drive to the point of maximum pull before the clutch balls override the ridges of the drive disc. If the maximum pull is less than 15 lbs. turn the 7/16" hex nut clockwise a slight amount, and recheck the maximum pull. If the pull is greater than 15 lbs., turn the 7/16" hex nut counter-clockwise a slight amount, and recheck pull. Repeat until the pull is set at 15 lbs.

6. Holding the 7/16" hex nut so it cannot turn, tighten the 3/8" hex nut against the 7/16" nut to lock it in place.

7. Disconnect spring scale and apply power to the green (up) terminal. Run the mast all the way out and allow the motor to continue running until the clutch has made a minimum of 15 engagements or clicks.

8. Do the same in the down position.

9. Run antenna up and down for a 3 minute period, then reassemble spring scale to mast and recheck for maximum pull. Adjust as necessary.

10. Snap front cover onto antenna drive and make sure that the vent hole is at the top when the mast is installed in car.

11. Reseal the assembly with body sealer and make sure that neither the vent hole in the drive cover, or the drain hole in the antenna drive is plugged.

f. Removal and Installation of Front Speaker (4400, 4600 and 4800 Series)

REMOVAL

1. Remove two screws from top front edge of radio grille and partially remove grille by pulling rear of grille back and upward.

2. Disconnect speaker connector and complete removal of grille and speaker.

3. Further disassembly of speaker from radio grille (see Figure 11-19) will be obvious on inspection.

INSTALLATION

4. Install front speaker reverse of removal.

g. Removal and Installation of Front Speaker (4700 Series)

REMOVAL

1. Remove four screws from front underside of instrument panel cover assembly (see Figure 11-20) and partially remove cover assembly by pulling assembly rearward until edge of upper tie bar is cleared, and then raising cover as far as possible.

2. Remove speaker connector and any other connectors attached to components on underside of cover assembly.

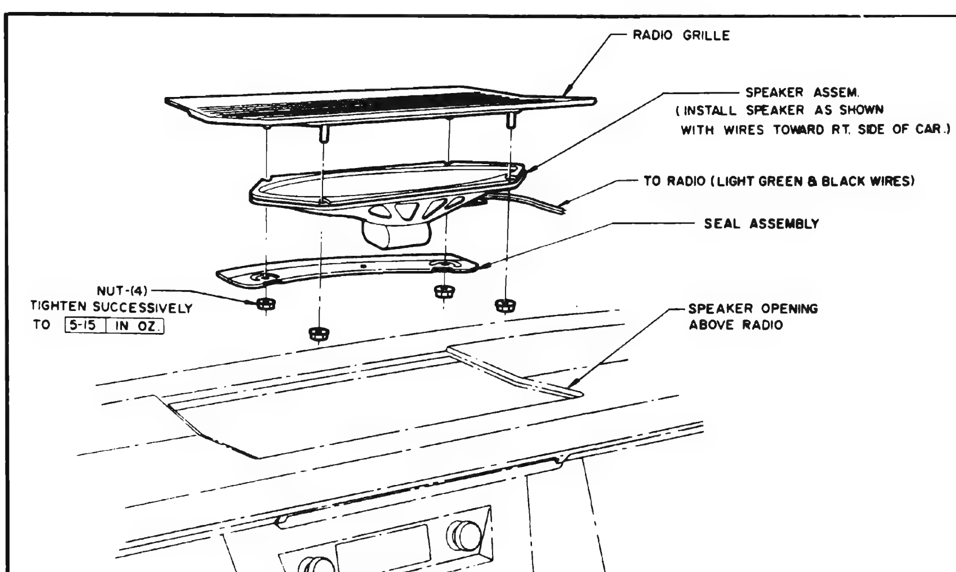


Figure 11-19—Front Radio Speaker Installation - 4400, 4600 and 4800 Series

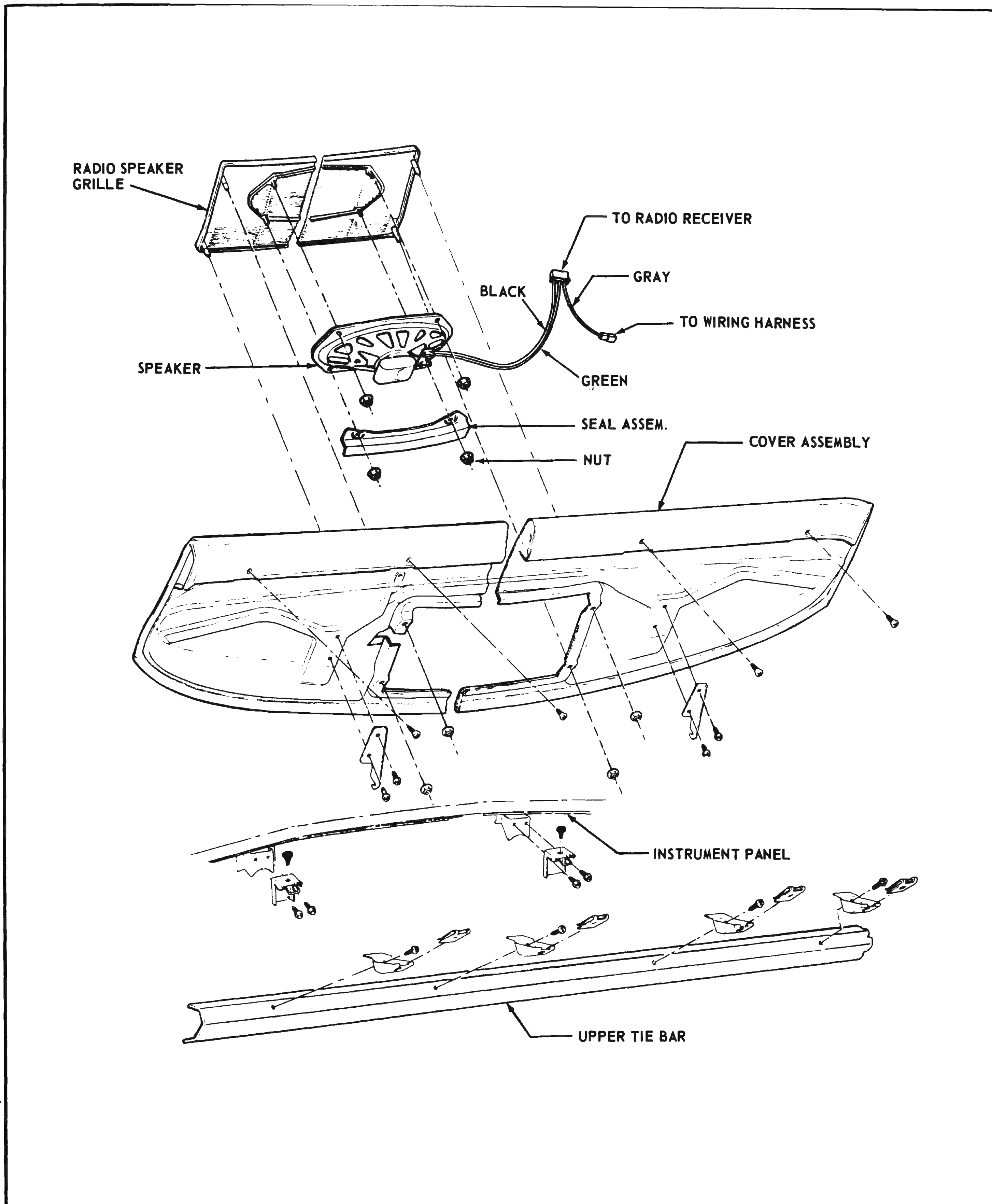


Figure 11-20—Front Radio Speaker Installation - 4700 Series

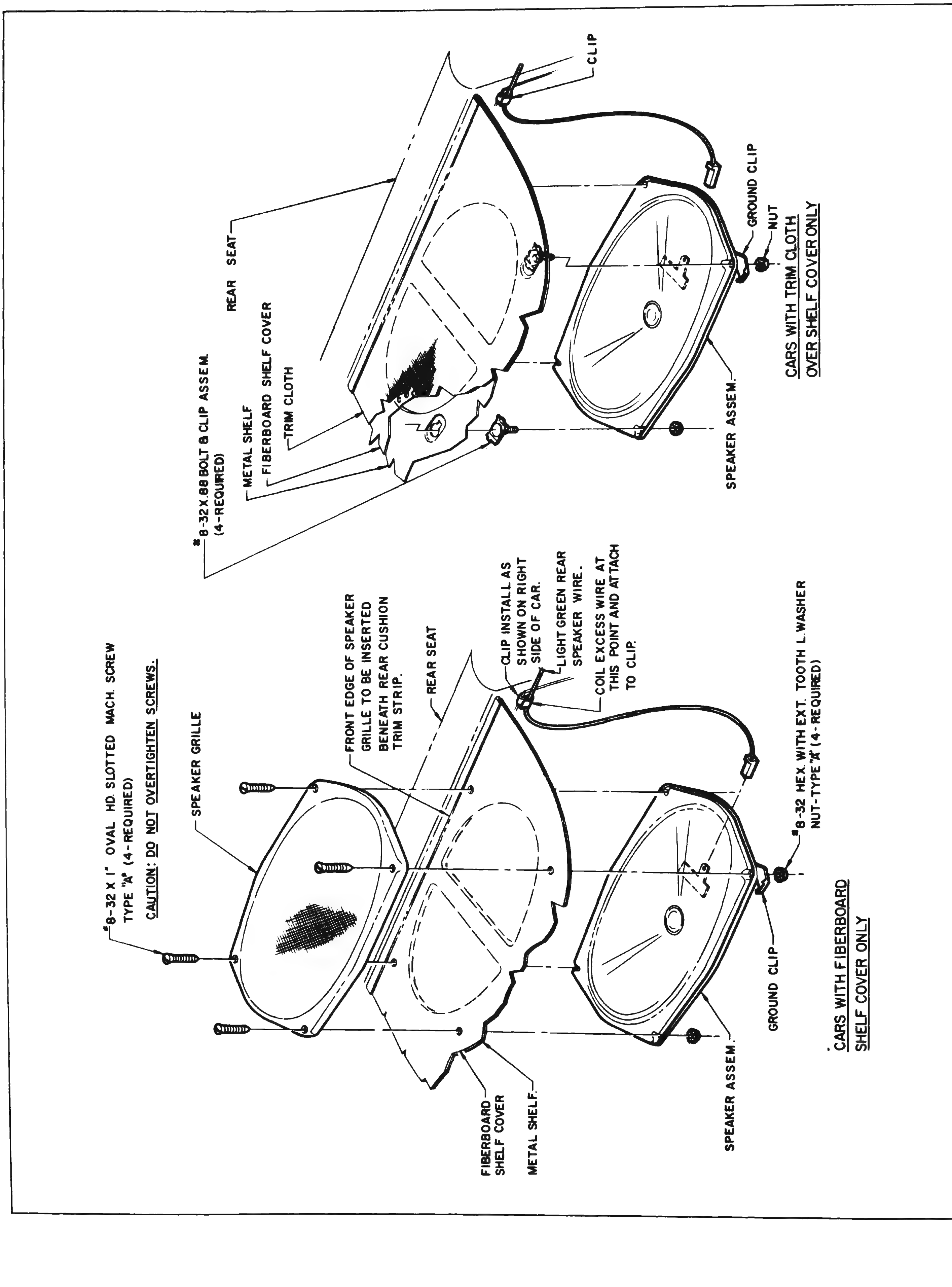


Figure 11-21—Rear Speaker Installation - 4400, 4600 and 4800 Series

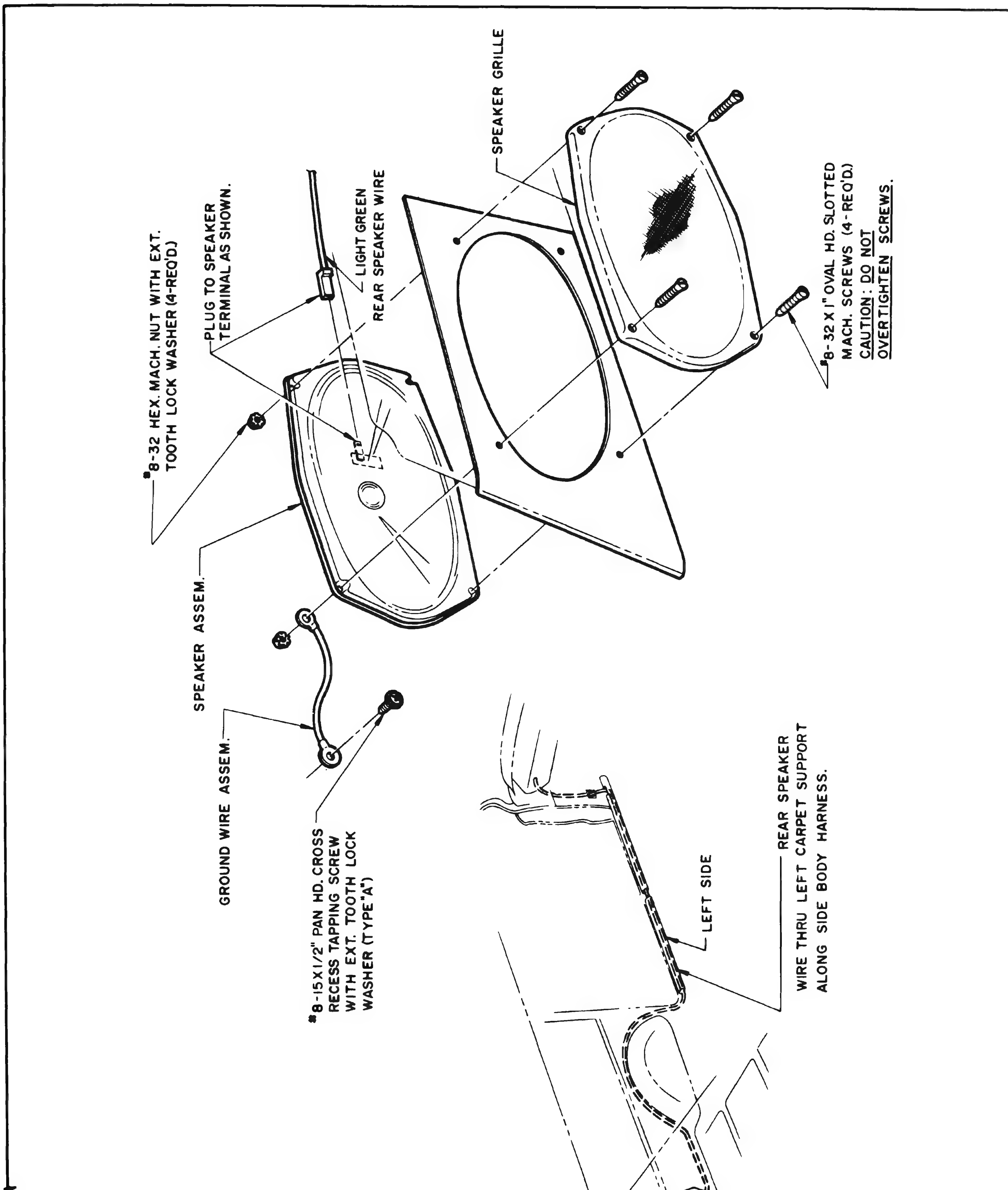


Figure 11-22—Rear Speaker Installation - Estate Wagon

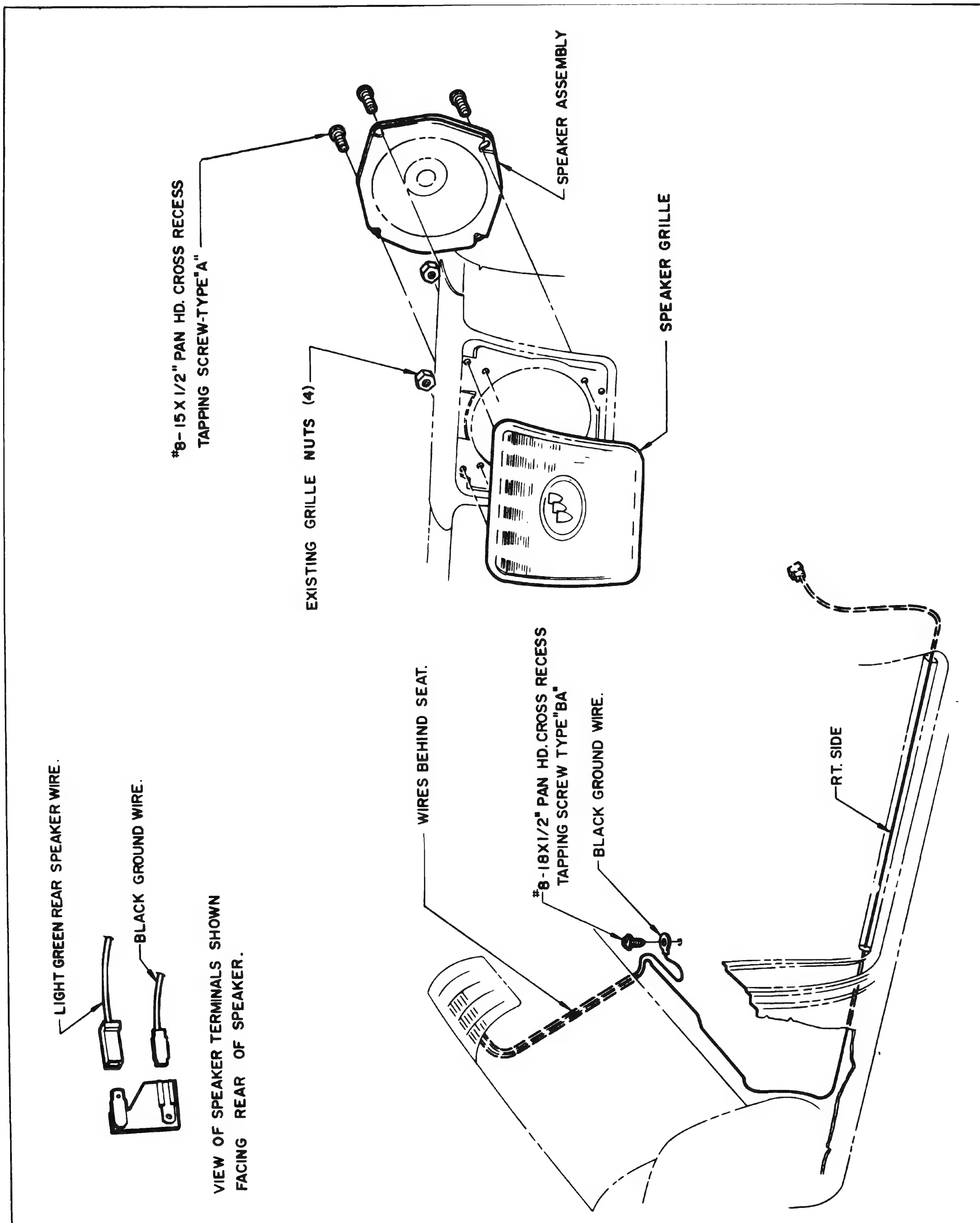


Figure 11-23—Rear Speaker Installation - Convertible

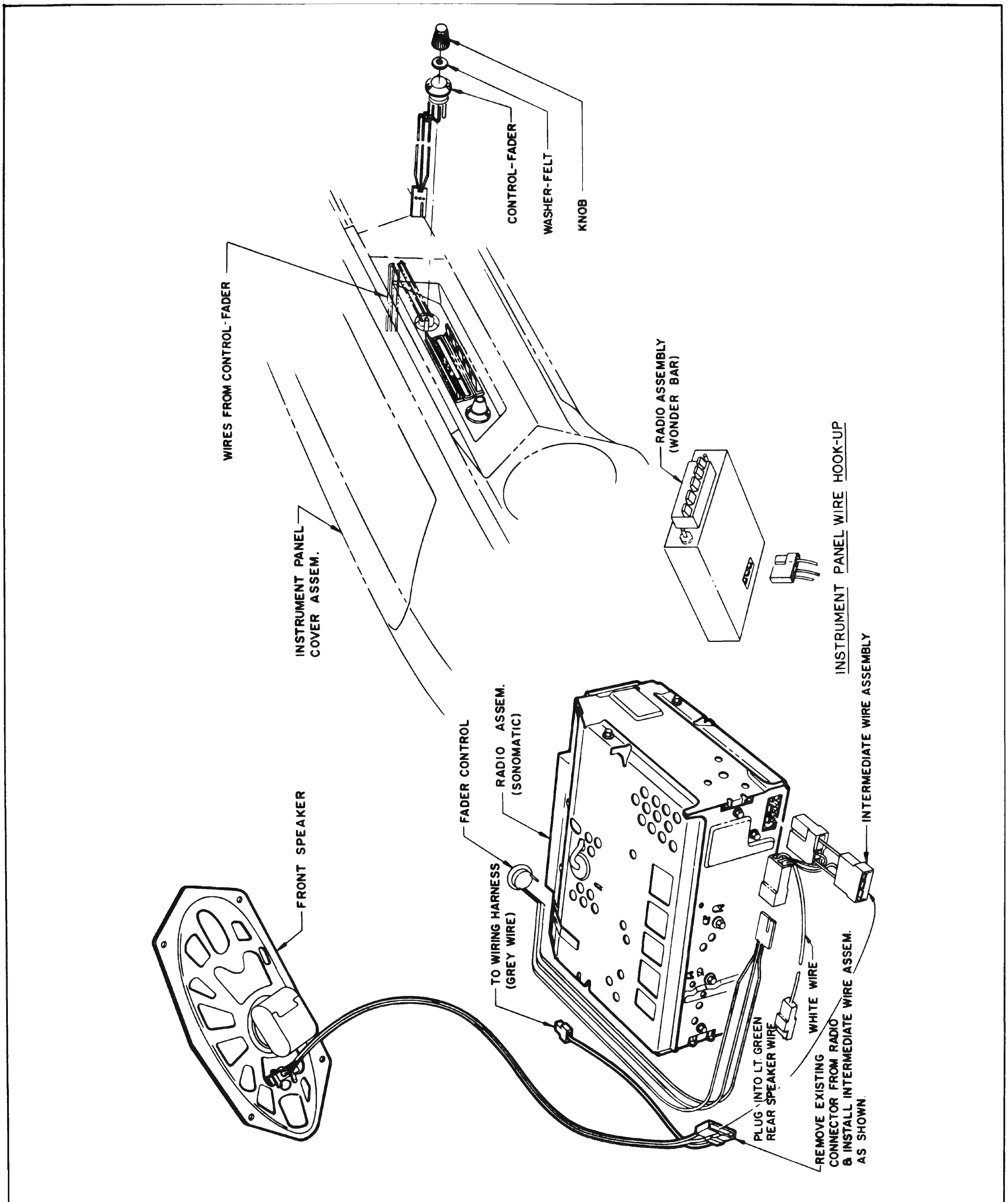


Figure 11-24—Rear Speaker Fader Control Switch Installation

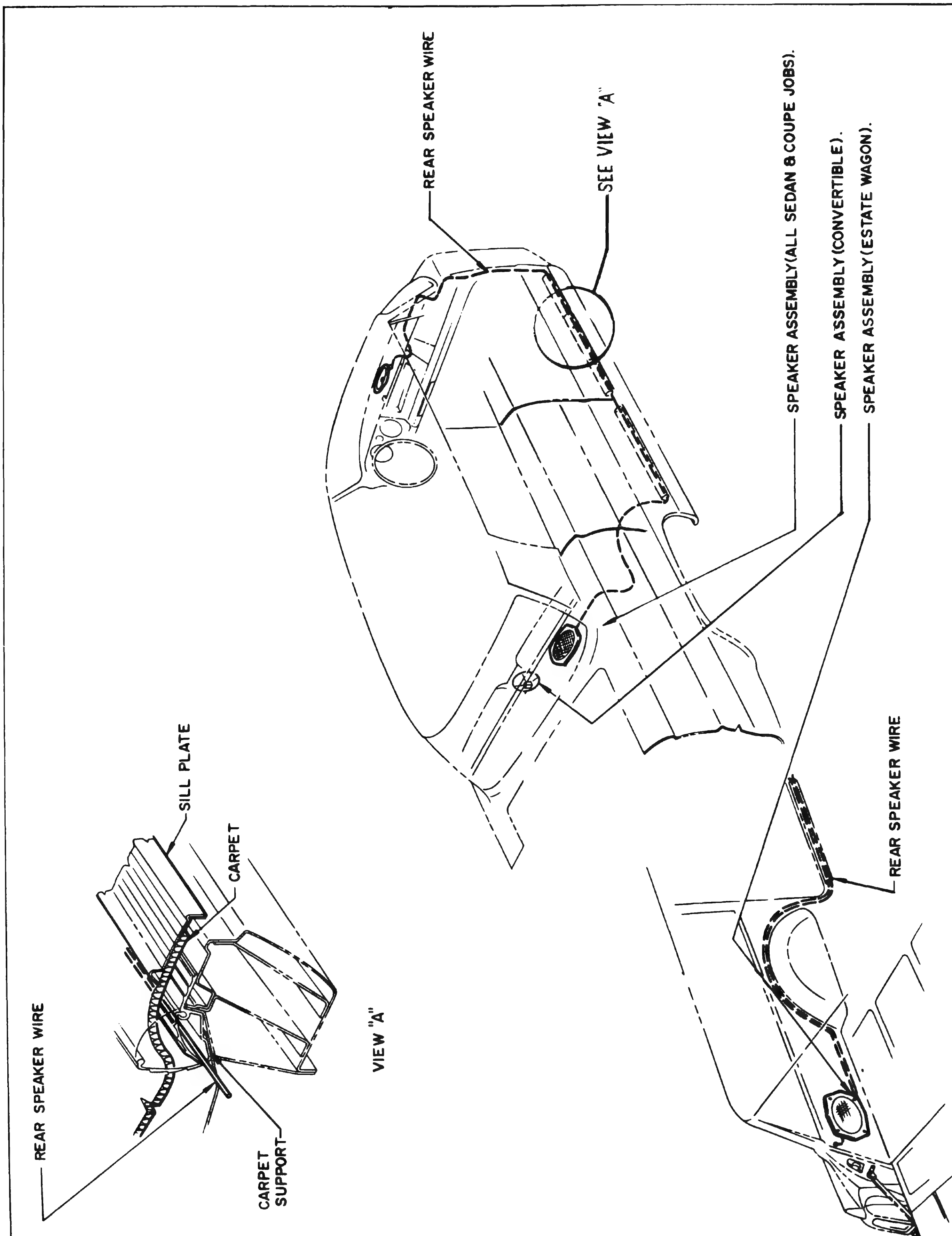


Figure 11-25—Rear Speaker Wiring - Sedans and Estate Wagons - 4400, 4600 and 4800 Series

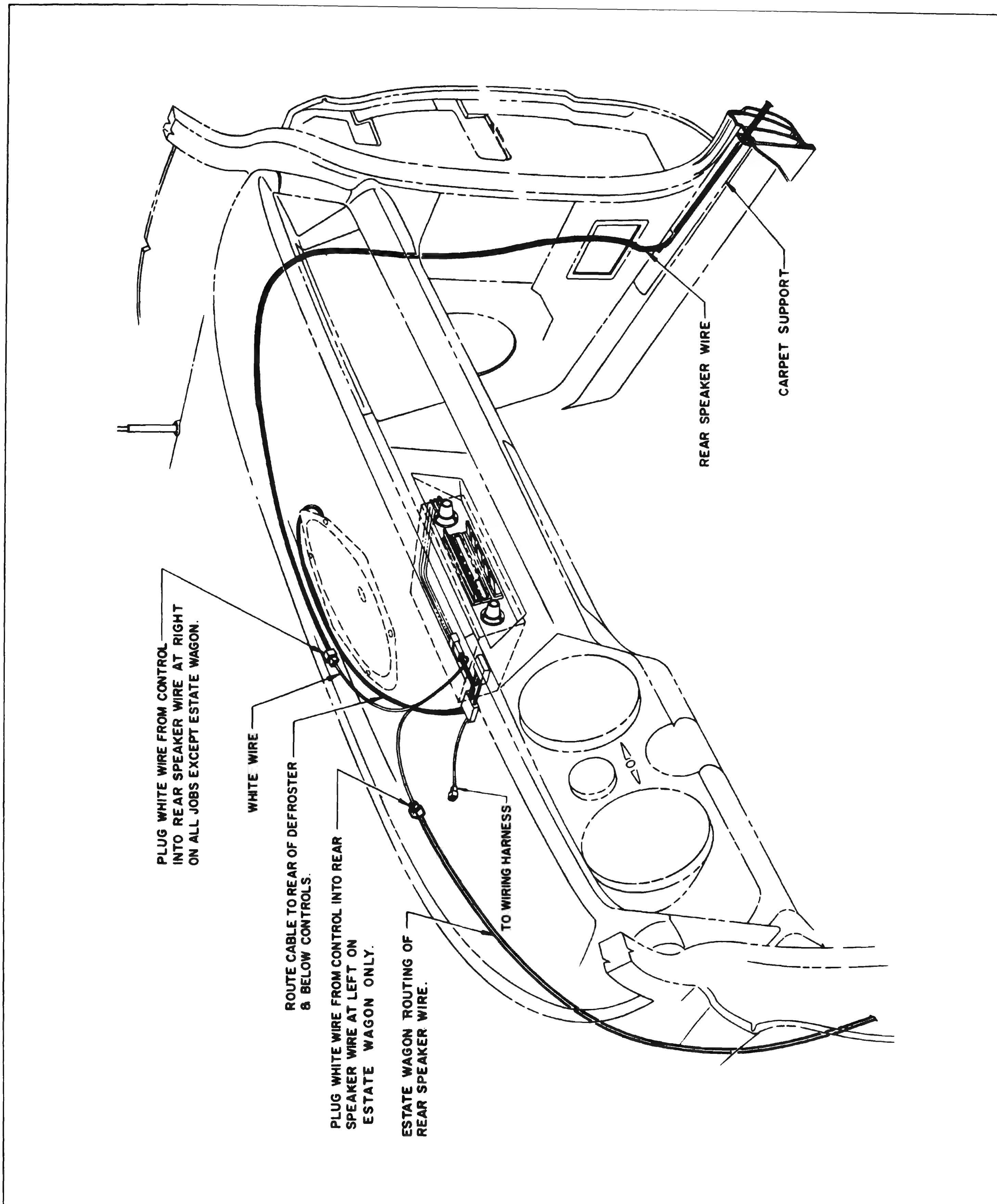


Figure 11-26—Rear Speaker Wire Routing

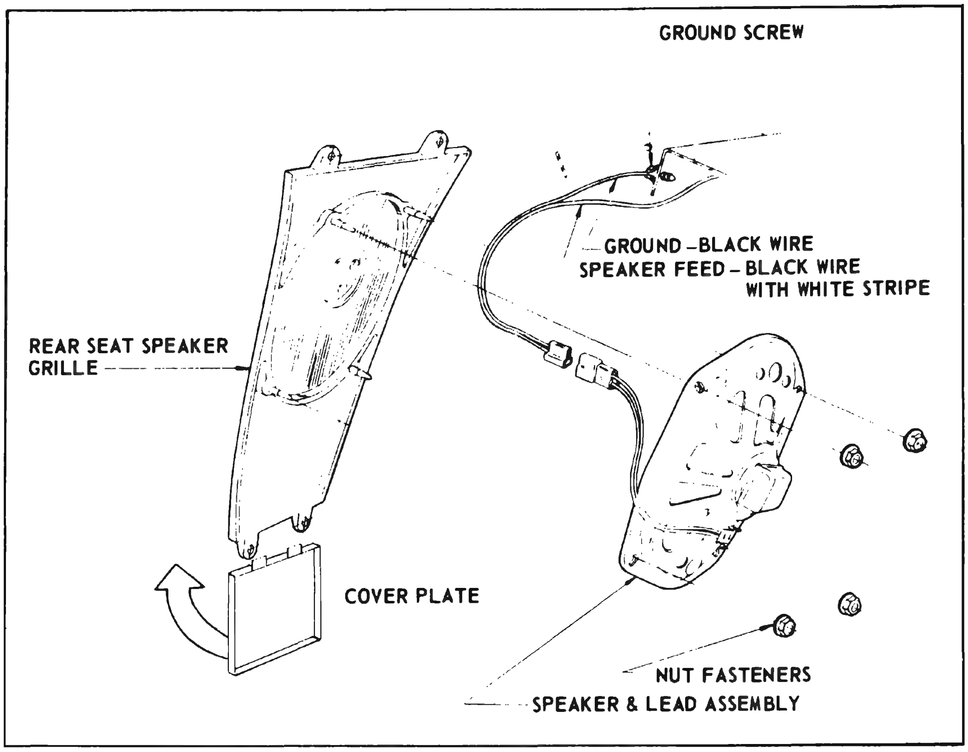


Figure 11-27—Rear Speaker Installation - 4700 Series

3. Complete removal of cover assembly and speaker grille.

CAUTION: Due to limited space, some difficulty may be encountered in removing cover assembly. Exercise care not to damage speaker magnet.

4. Further disassembly of cover and speaker grille will be obvious on inspection.

INSTALLATION

5. Install front speaker reverse of removal.

h. Removal and Installation of Rear Speaker (4400, 4600 & 4800 Series)

Removal and installation of rear speaker will be evident on inspection (see Figures 11-21 through 11-26).

i. Removal and Installation of Rear Speaker (4700 Series)

REMOVAL

1. Remove cover plate (see Figure 11-27) located directly under the rear speaker grille by grasping lower edges and firmly pulling rearward. Cover plate is wedged between rear seat cushions.

2. Remove two screws from lower end of rear speaker grille and partially remove grille by pulling lower end of grille outward and sliding grille down and out.

3. Disconnect speaker connector and complete removal of speaker and grille.

4. Further disassembly of speaker and grille will be evident on inspection.

INSTALLATION

5. Install rear speaker reverse of removal.

11-4 RADIO ADJUSTMENTS—ON CAR

When making the adjustments covered in this paragraph, it is essential to have the car in a location that is as free as possible from outside interference.

a. Antenna Trimmer Adjustment

An antenna trimmer adjustment is provided for matching the antenna to the receiver. This adjustment must always be made after installation of receiver and antenna, or after any repairs of these units. The adjustment should also be checked whenever the radio reception is unsatisfactory.

1. Raise antenna to 28 inches.

2. Tune radio to a station between 600 and 1000 KC that can barely be heard with volume turned full on.

3. Remove right inner and outer knobs and insert a screwdriver in the trimmer screw (see Figures 11-6 and 11-7). Rotate trimmer screw until maximum volume is achieved.

4. Install right inner and outer knobs.

b. Setting Push Buttons to Desired Stations

1. Turn on the radio.

2. Pull push buttons outward. It is desirable to set up the push buttons in logical sequence. For example - lowest frequency of desired station on first button, next higher frequency station on second button, etc.

3. Carefully tune in the desired station manually, then push the button all the way in.

4. Move dial pointer away from the selected station and push the button to make certain the station will be properly tuned in.

5. Turn tuning knob back and forth to make certain that best tuning is obtained with the push button. If best tuning is not obtained, repeat Steps 2, 3 and 4.

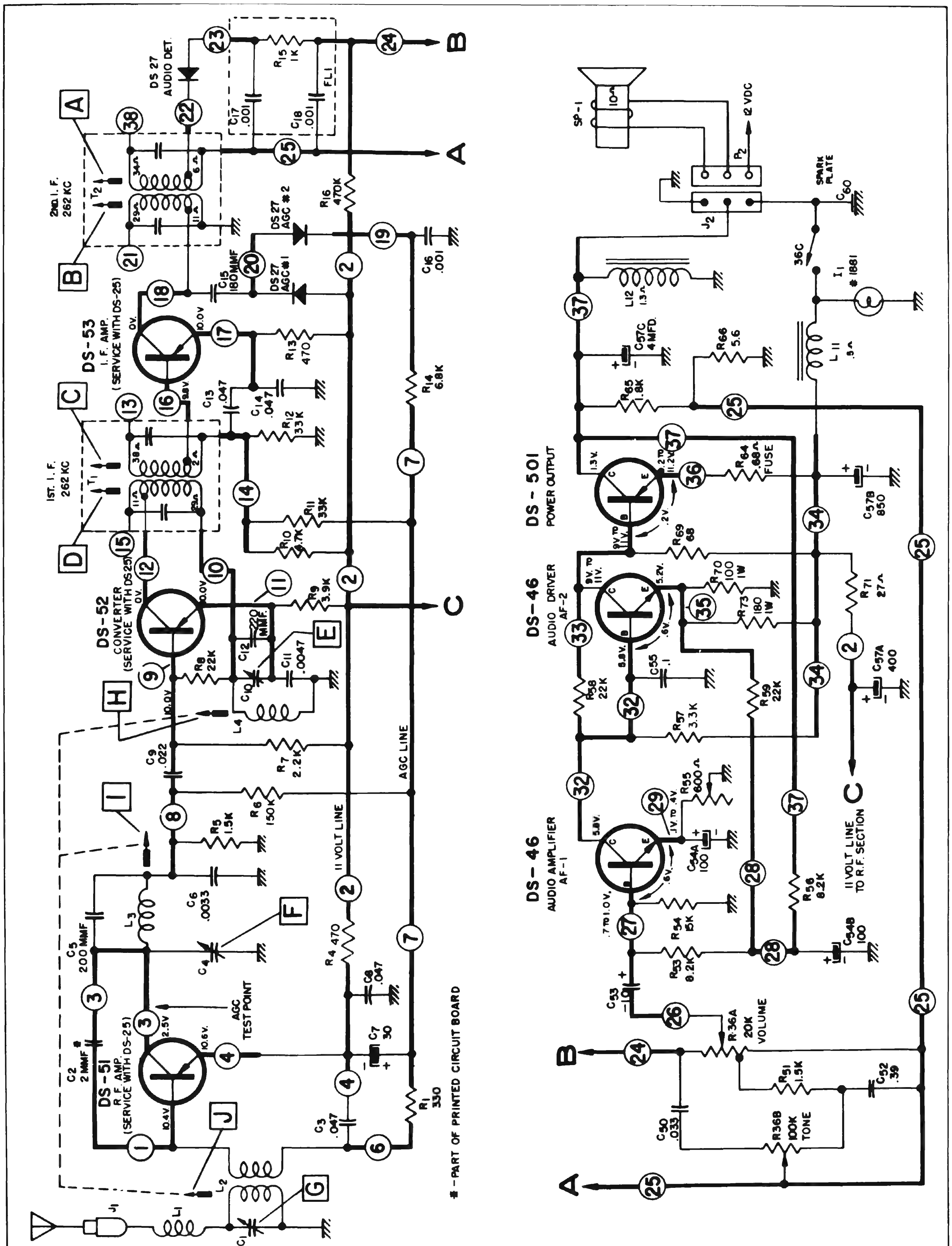


Figure 11-28—Sonomatic Radio Circuit Schematic

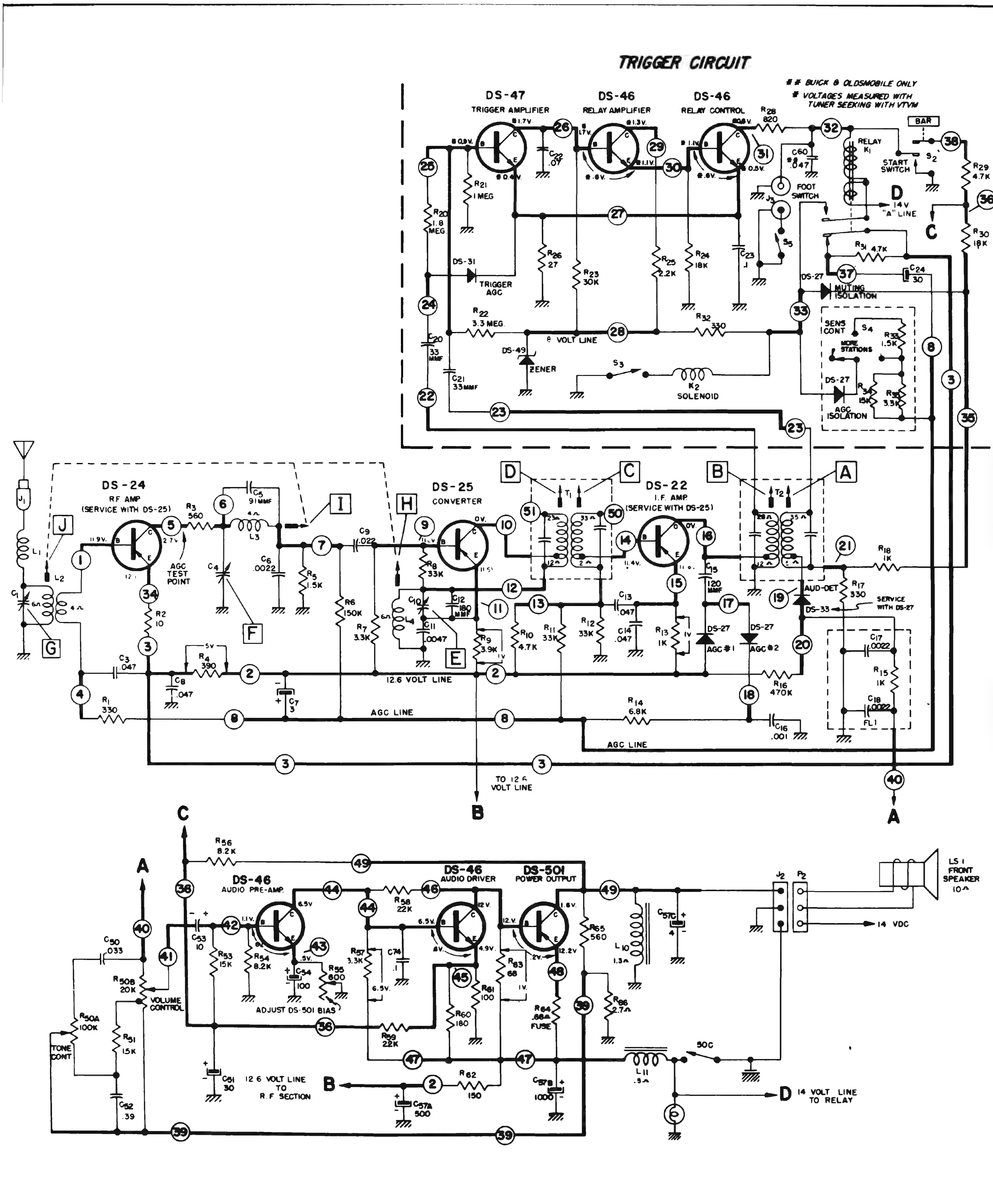


Figure 11-29—Wonderbar Radio Circuit Schematic

SECTION 11-B
HEATER SYSTEM

CONTENTS OF SECTION 11-B

11-5 DESCRIPTION AND OPERATION OF HEATER SYSTEM (4400-4600 AND 4800 SERIES)

The heater system for the 4400, 4600 and 4800 Series cars is a air-mix type system in which the temperature of the air is varied by diluting heated air with unheated air. The outside air, after it enters the system, is divided into two air streams. Part of the air flow is diverted to the heater core and the balance of the air flow is by-passed around the heater core.

The heater system consists of four major assemblies: (1) a blower and air inlet assembly (see Figure 11-30) which contains the blower fan and motor, and outside air door; (2) a heater assembly which houses the heater core, temperature door and defroster door; (3) right and left floor ducts, and also a floor duct adapter which houses the rear heat door; (4) a heater control assembly (see Figure 11-31) which regulates the opening and closing of doors in system.

The flow of coolant through the heater system is as shown in Figure 11-32 for 4400 Series cars, and Figure 11-33 for 4600 and 4800 Series cars. A manual gate water valve shuts off circulation of coolant through the heater core when system is not operating.

a. Description of Air Flow

The air flow begins at air intake

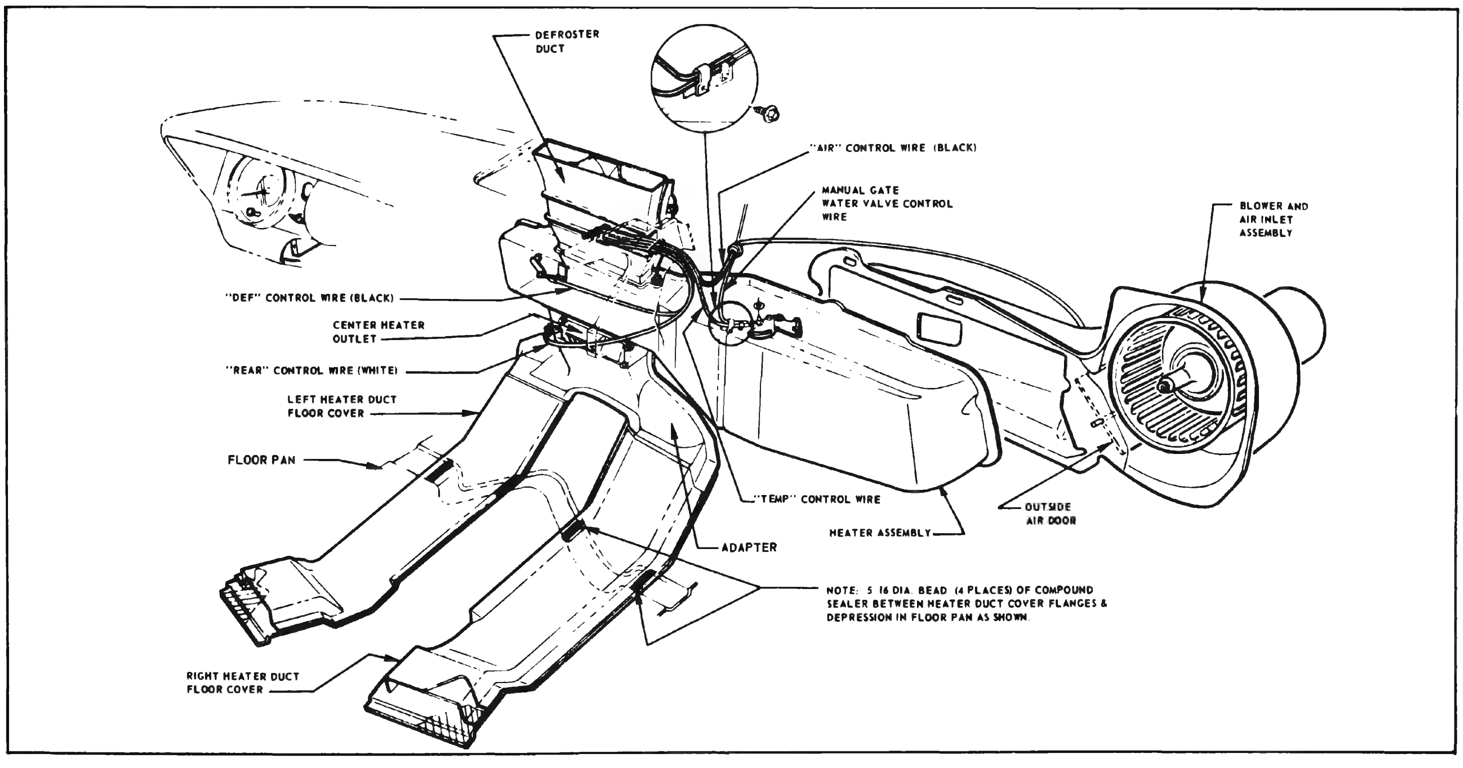


Figure 11-30—Heater System - 4400, 4600 and 4800 Series

grille located on the cowl forward of the windshield (see Figure 11-34). The outside air passes through the air intake grille into the cowl air chamber, and then into the blower and air inlet assembly (see Figure 11-30). The air flows through the blower, past the open outside air door and to the heater assembly.

At the heater assembly, the air stream divides and may flow through the heater core or through the duct by-passing the core. The regulation of the flow of air at this point is controlled by the temperature door. When the door is fully closed, air flow through heater core is blocked and all air is forced to circulate around the core. When the door is fully open, the air stream through the by-pass around the core is blocked and all air is forced through the heater core. Intermediate positioning of the door mixes heated and unheated air in proportionate amounts.

After the air passes through or around, or both through and around the heater core, it is directed to the defroster door. When the defroster door is closed all air is channeled to the front and/or rear floor area. When the defroster door is fully open all air is ducted to the defroster outlet. Intermediate positioning of the defroster valve apportions air to both the defroster and the floor. Depending on how much heat is being directed to the defroster outlet, the balance of the air stream will flow through the center heater outlet (see Figure 11-34) to the front floor area and to the rear floor area through rear floor ducts. The air flow to the rear floor is regulated by the rear heat door.

b. Description and Operation of Heater System Controls

The heater system for 4400, 4600 and 4800 Series cars consists of four controls: AIR, TEMP, DEFR, and REAR control levers (see Figure 11-35). They function as follows:

1. AIR Control Lever—The AIR control lever regulates the positioning of the outside air door, and operation of the blower motor. The lever has four positions. The first position opens the outside air door which must be open to initiate air circulation through the system. The second, third and fourth positions activate the blower motor to low, medium and high speeds.

The heater door control assembly (see Figure 11-36) actually performs the afore mentioned functions. The unit is located on the blower and air inlet assembly and is directly linked to the outside air door. In addition, the unit houses the heater blower switch. A control cable directly connects the heater door control assembly to the AIR lever.

2. TEMP Control Lever—The TEMP control lever opens or closes the temperature door, and also manual gate valve. Movement of the control forward dilutes heated air with gradually decreasing amounts of unheated air.

3. DEFR Control Lever—This lever regulates the opening and closing of the defroster door. Positioning of the lever forward diverts the air flow to the defroster outlet. The defroster door will divert all of, or a portion of the available air to the defroster outlets.

4. REAR Control Lever—The rear control lever opens and closes the rear heat door located in the adapter assembly. When this door is open it diverts an amount of air, proportionate to its opening, to the rear seat.

c. Description of Ventilation Doors

An outside air vent is provided on each of the floor side kick pads. The opening and closing of the vent doors is controlled by a LEFT VENT and a RIGHT VENT control knob on the instrument panel.

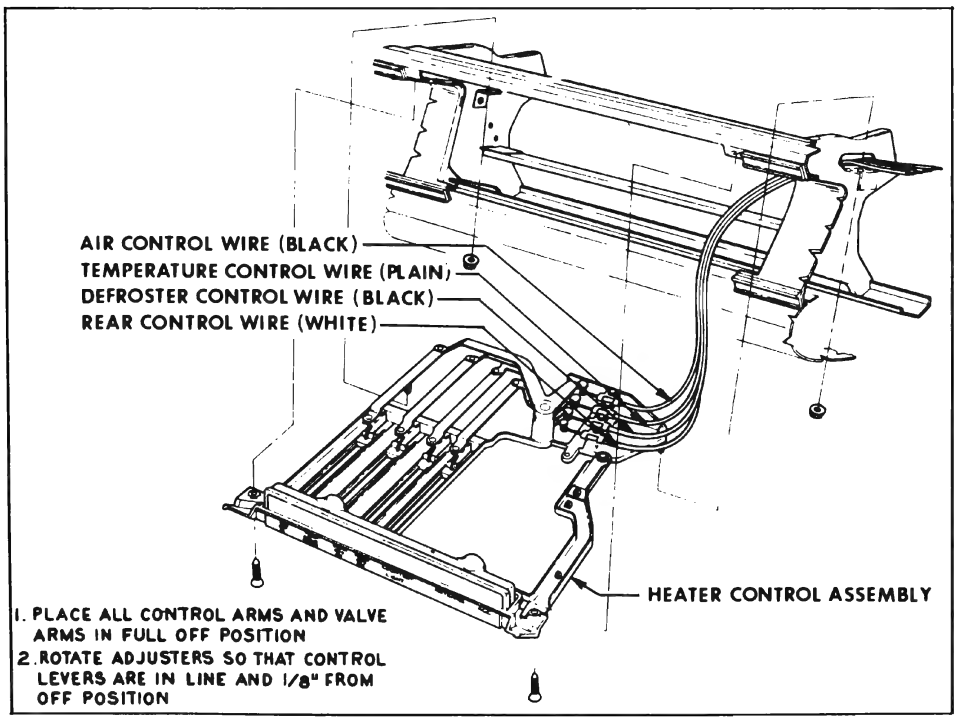
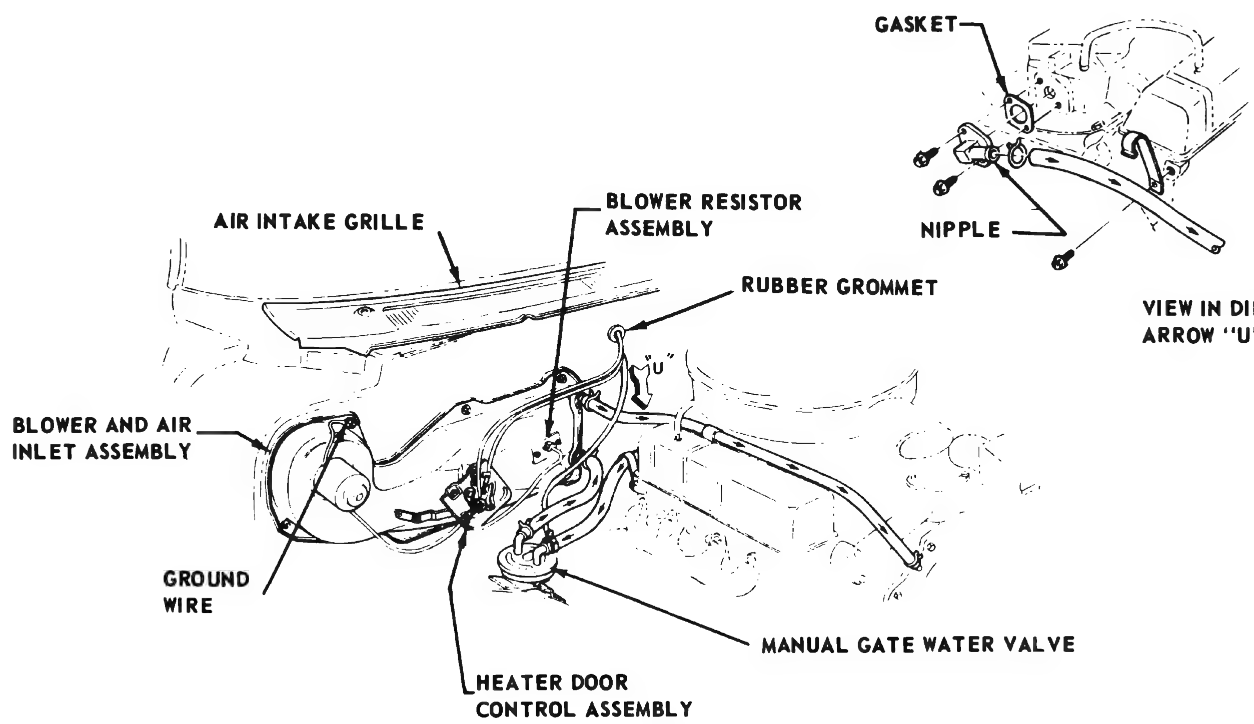


Figure 11-31—Heater Control Wire Adjustment - 4400, 4600 and 4800 Series



NOTE: HEATER HOSE ASSEMBLY PRECAUTIONS

1-HOSE MUST BE PUSHED ON EACH CONNECTION AS FAR AS POSSIBLE.

2-HOSE CLAMPS MUST BE INSTALLED STRAIGHT, AWAY FROM END OF HOSE AND SLIGHTLY BEHIND BEAD ON EACH CONNECTION.

3-NOT PERMISSABLE TO USE ANY WETTING AGENTS TO ASSIST HOSE ASSEMBLY.

4-TIGHTEN ALL SCREW TYPE CLAMPS TO 16–22 LB.-IN.

5-DO NOT OVERSPREAD SPRING TYPE HOSE CLAMPS DURING ASSEMBLY -- USE PROPER TOOL WITH SPACERS.

Figure 11-32—Heater System Water Flow - 4400 Series

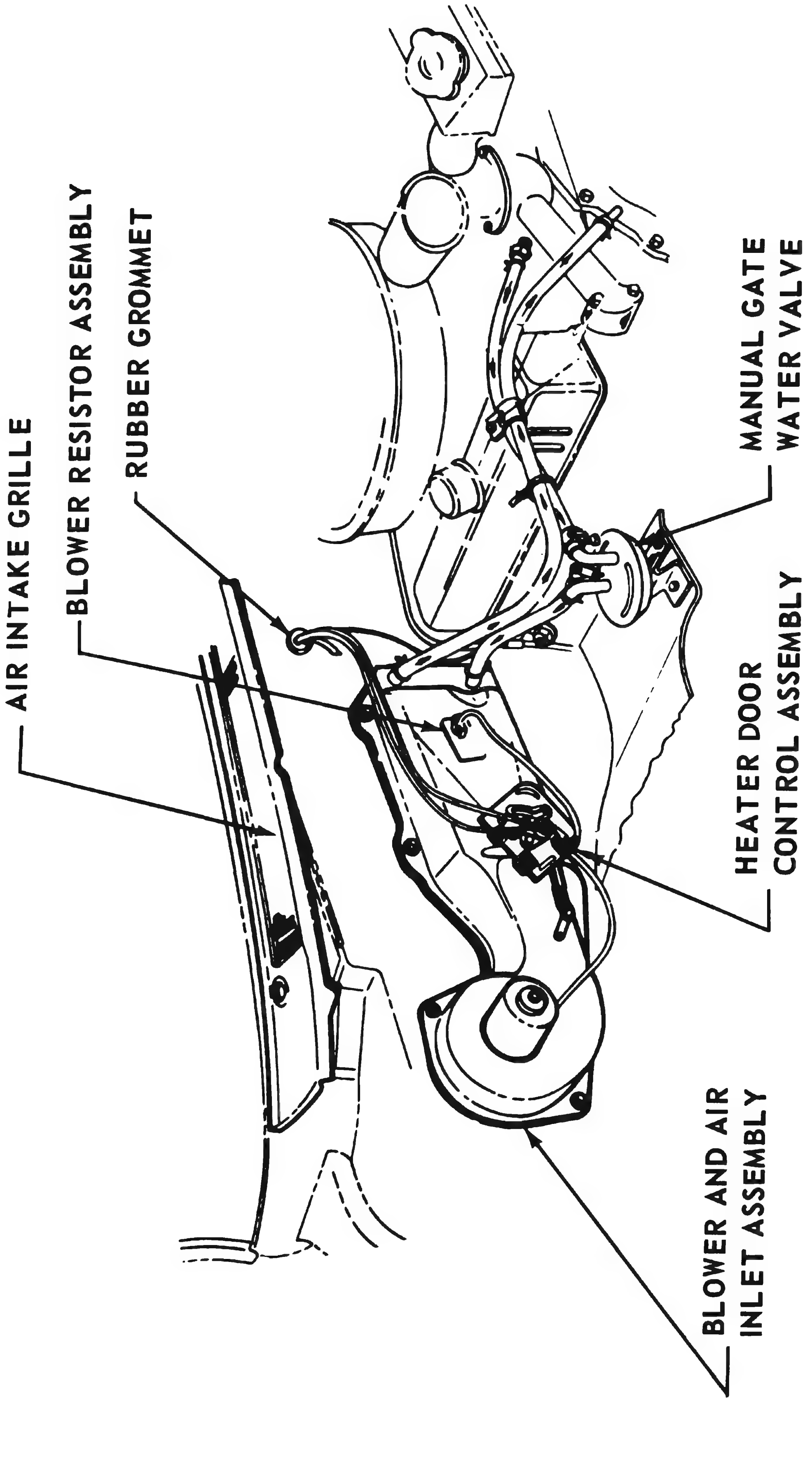


Figure 11-33—Heater System Water Flow - 4600 and 4800 Series

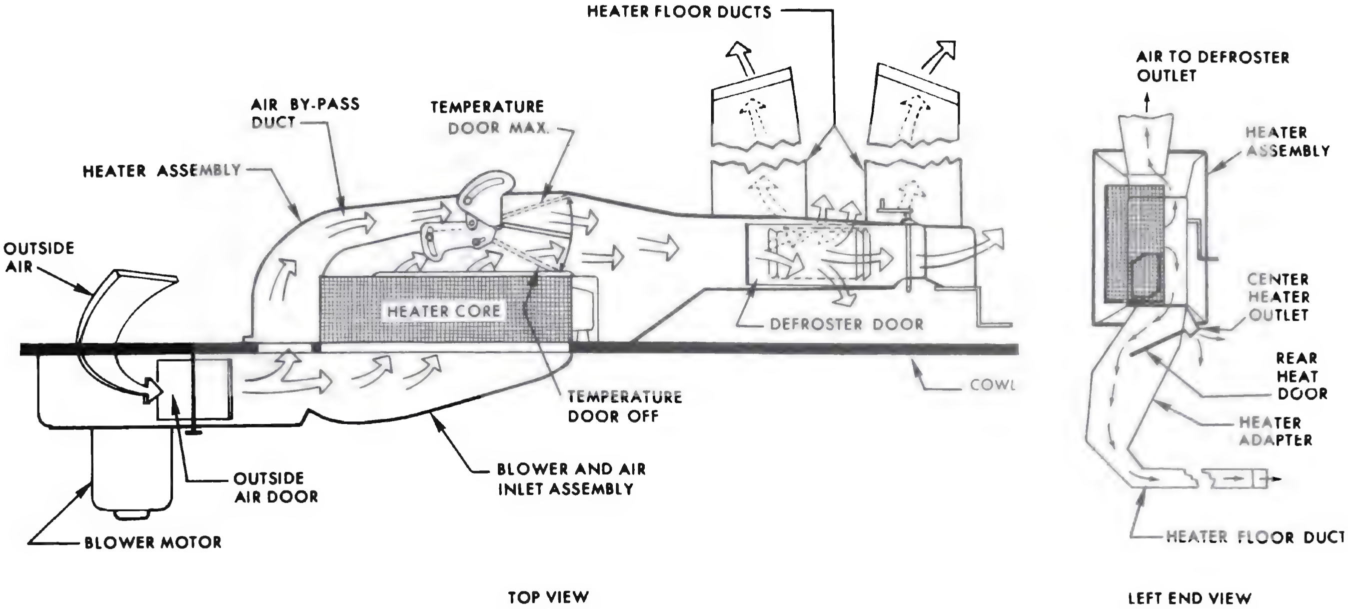


Figure 11-34—Heater System Air Flow - 4400, 4600 and 4800 Series

11-6 DESCRIPTION AND OPERATION OF HEATER SYSTEM (4700 SERIES)

The heater system for the 4700 series cars is essentially similar to the system for 4400, 4600 and 4800 series cars in so far as it is an air-mix type system, and the air flow is basically the same. The heater system has six major assemblies: (1) a blower assembly (see Figure 11-37) which houses the blower fan and motor; (2) an outside air door and case assembly which contains the outside air door, blower resistor assembly and the vacuum diaphragm to operate the door; (3) the air inlet assembly which houses the temperature door; (4) a heater assembly which contains the heater core; (5) console center duct and adapter assemblies (see Figure 11-38); (6) a heater and defroster control assembly which controls regulation of doors and blower motor.

The flow of coolant thru the heater system is as shown in Figure 11-39. A manual gate water valve shuts off flow of coolant thru heater core when system inoperative.

a. Description of Air Flow

The air flow (see Figure 11-40) is similar to 4400, 4600, and 4800 series heater system, except that the temperature door is located in the air inlet assembly. In addition, no rear heat door is provided so that there is a constant flow of heat to the rear outlets as well as the front outlets when air is being directed to the floor of the car.

b. Description and Operation of Heater System Controls

The heater system for the 4700 series cars has three control levers: HEATER TEMP lever, DEFROSTER lever, and BLOWER lever (see Figure 11-41). They function as follows:

Figure 11-35—Heater System Control Levers - 4400, 4600 and 4800 Series

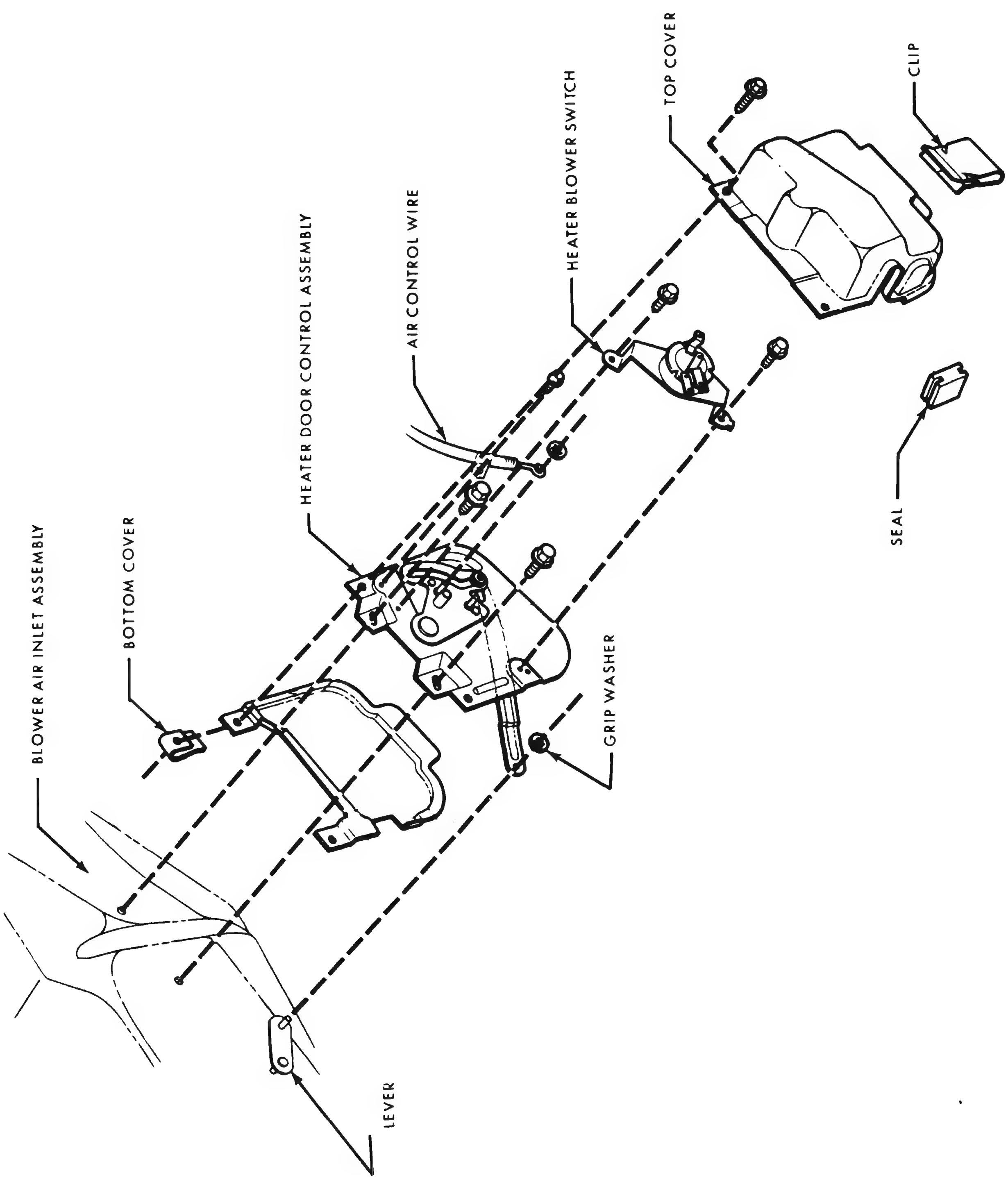


Figure 11-36—Heater Door Control Assembly - 4400, 4600 and 4800 Series

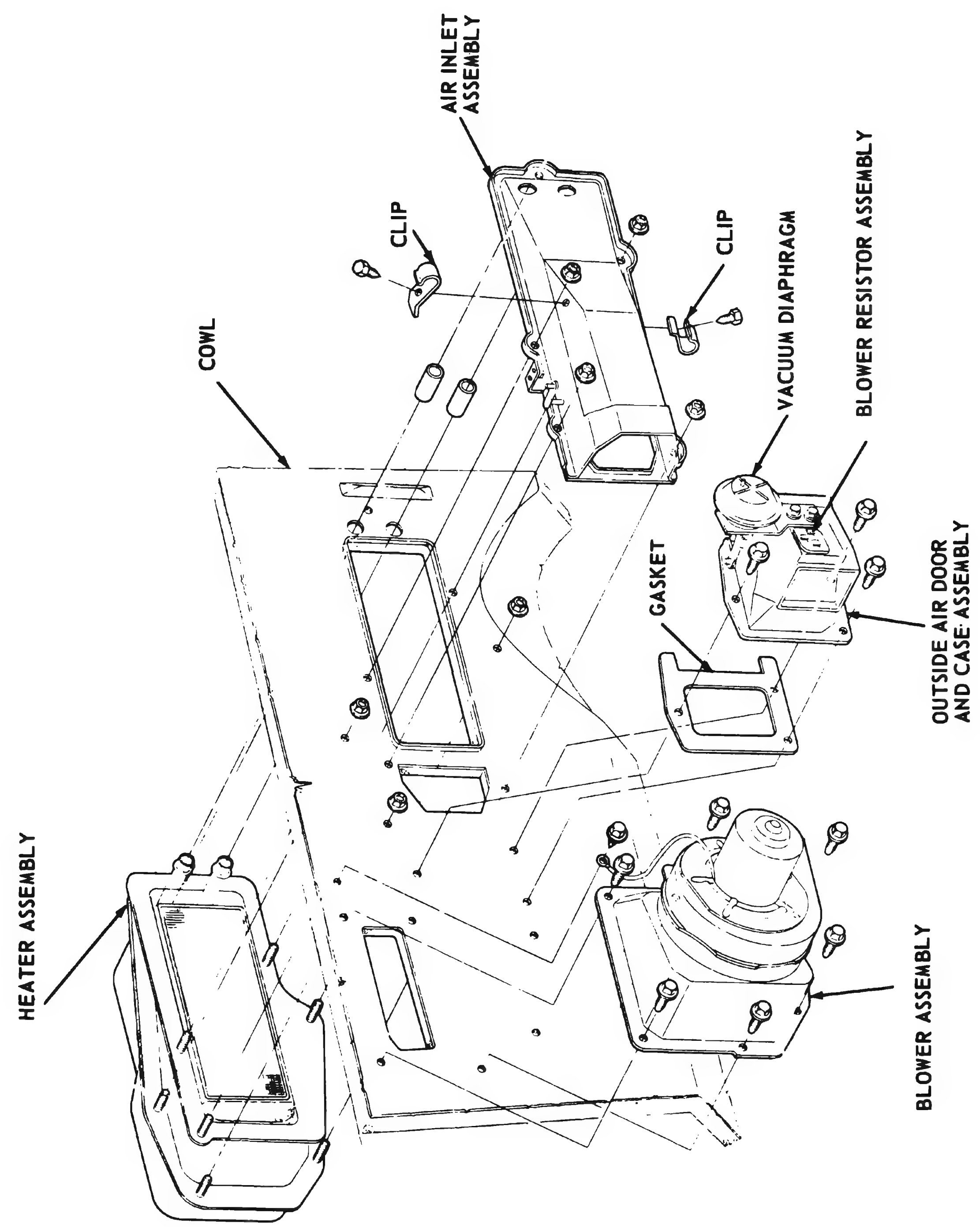


Figure 11-37—Heater System Installation - 4700 Series

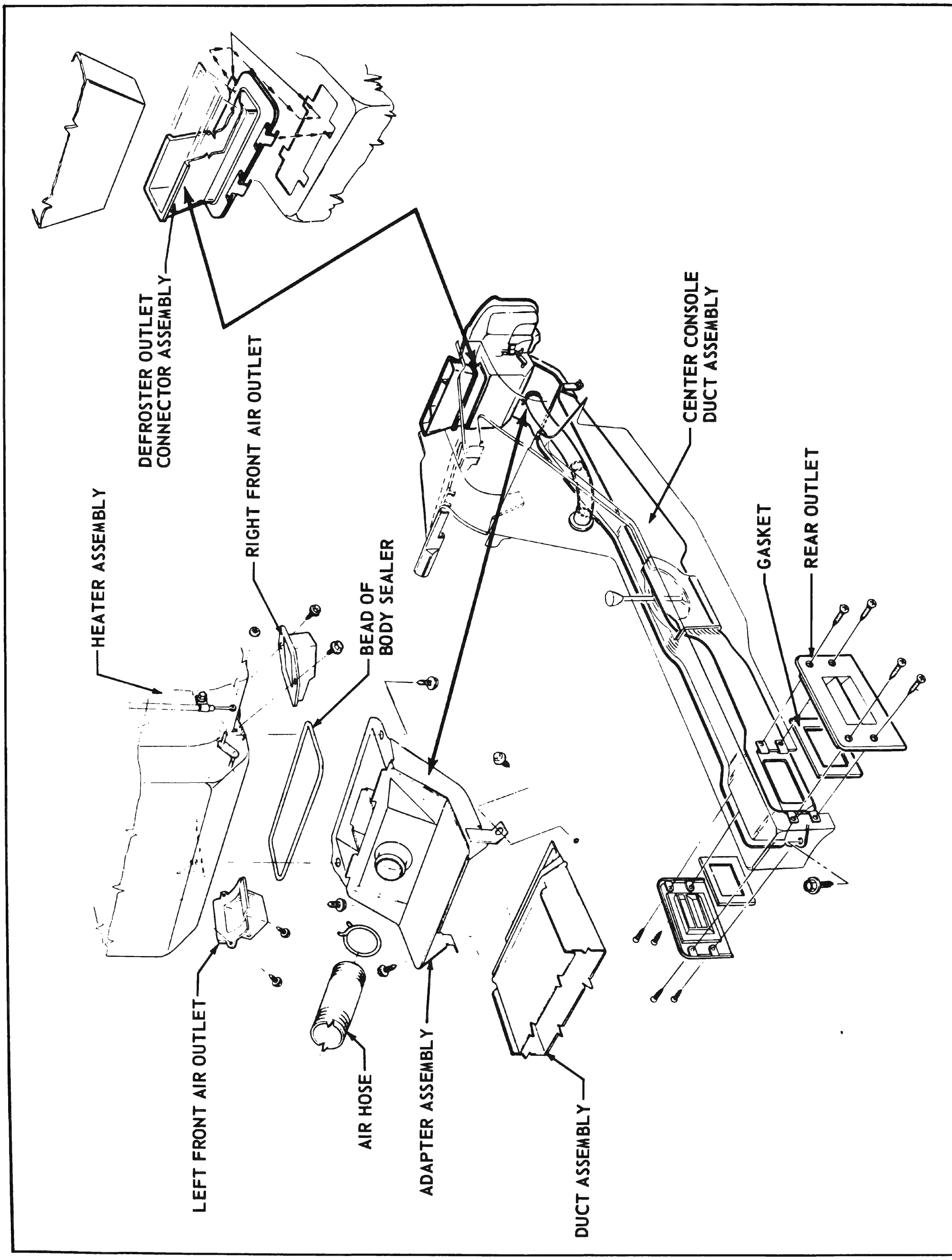


Figure 11-38—Heater System Installation - 4700 Series

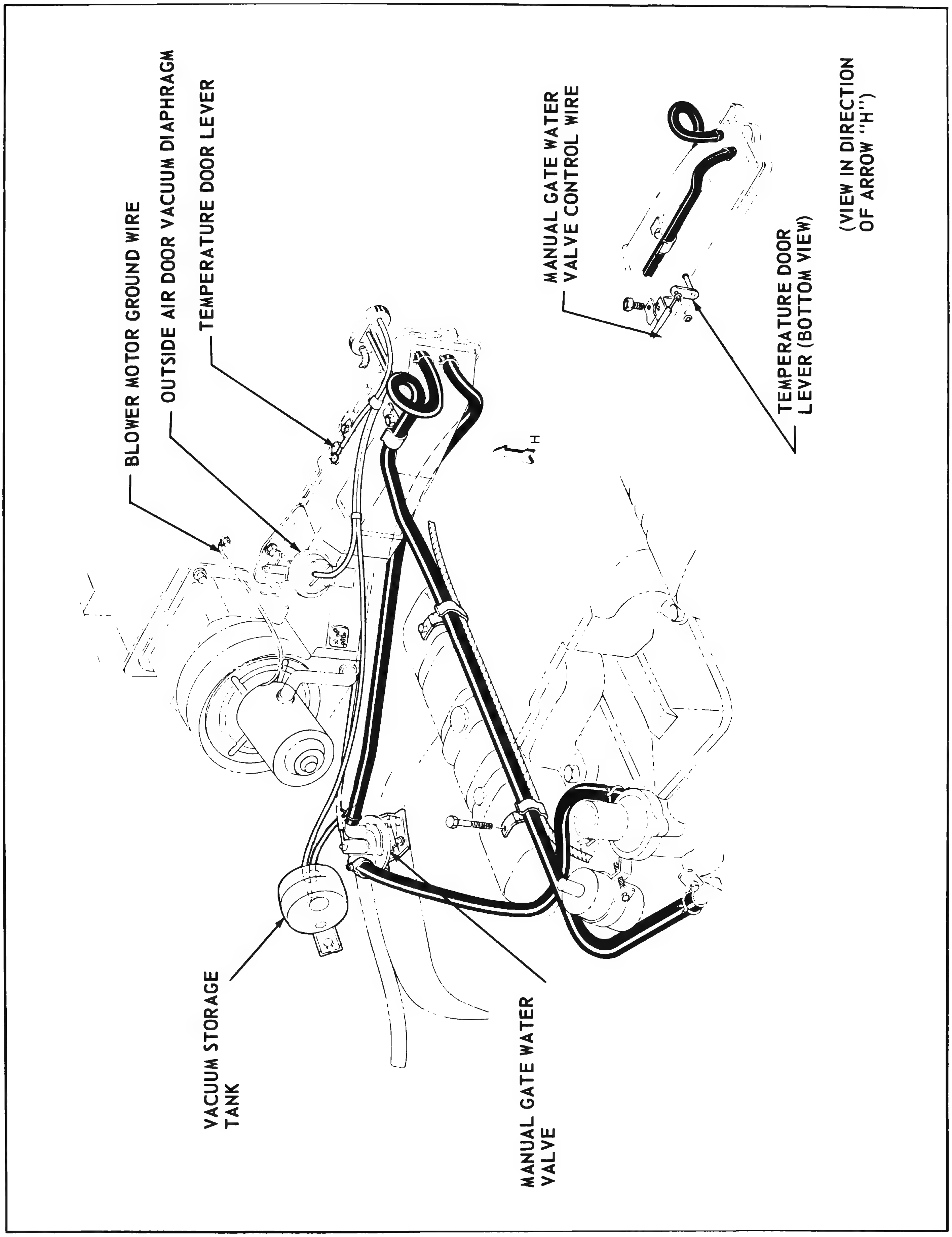


Figure 11-39—Heater System Coolant Circulation - 4700 Series

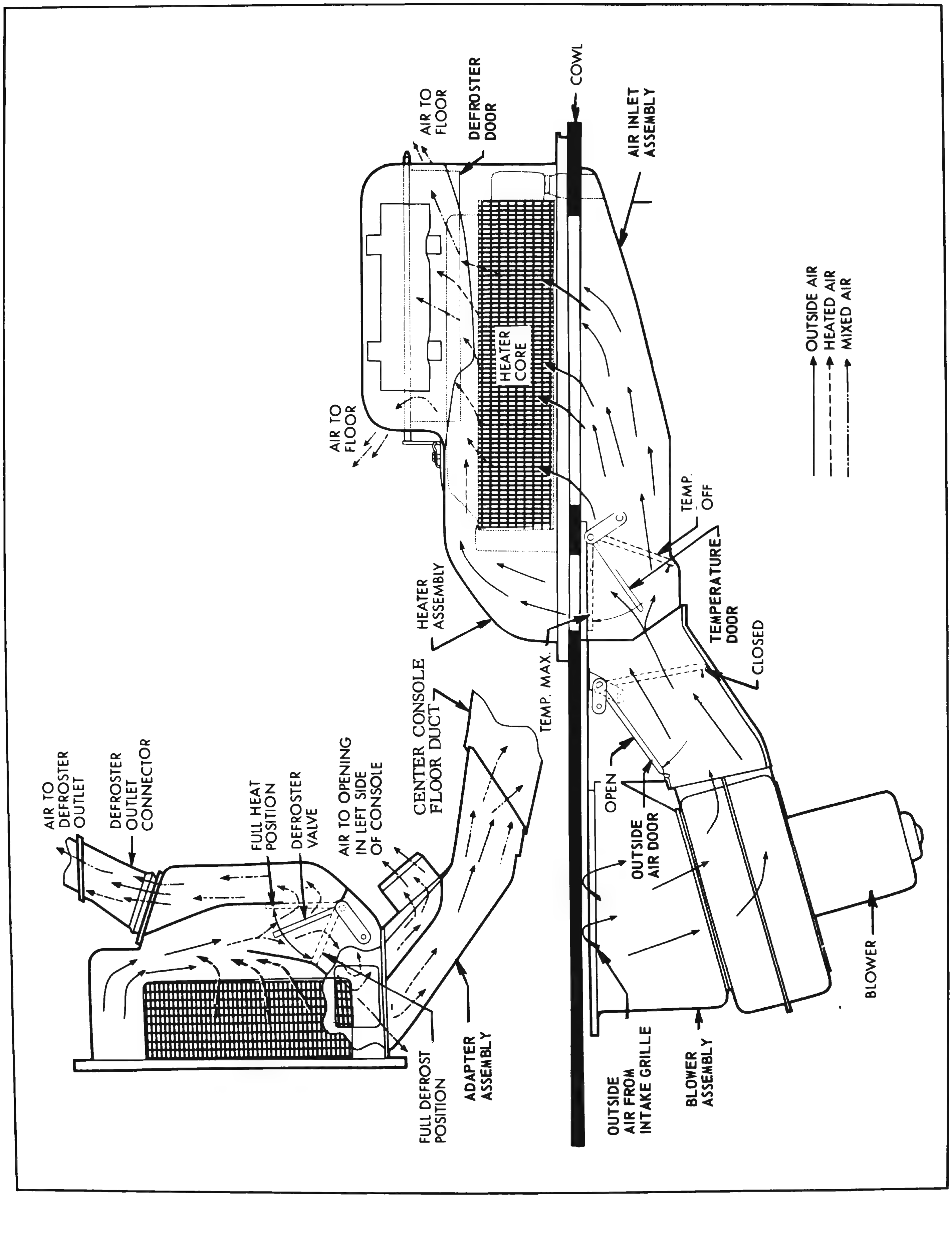


Figure 11-40—Heater Air Flow - 4700 Series

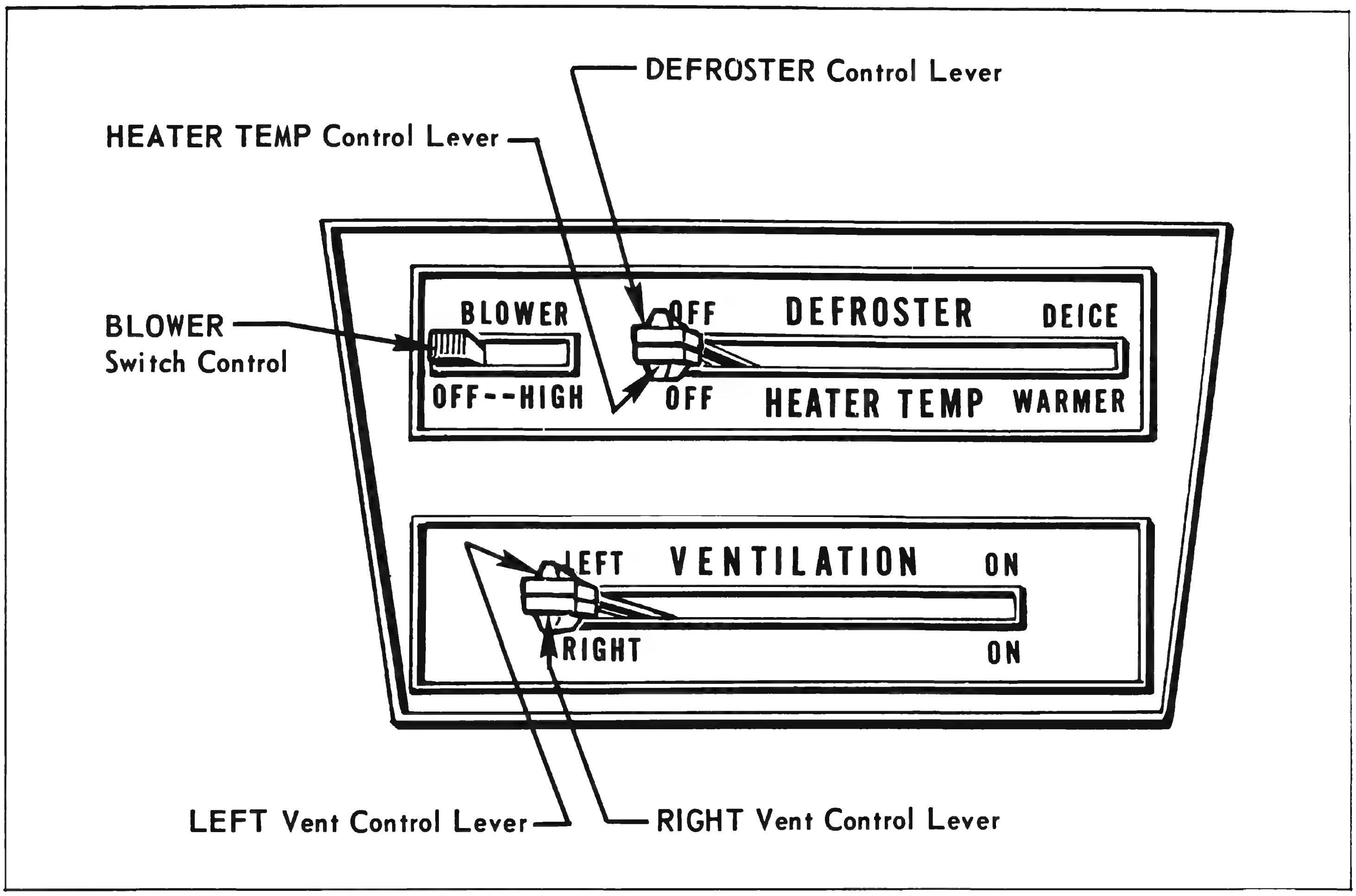


Figure 11-41—Heater System Control Levers - 4700 Series

1. HEATER TEMP Control Lever - This lever regulates the positioning of the temperature door, outside air door, closes one of the electrical switches necessary for operation of the blower motor, and also opens the manual gate water valve. Initial movement of the lever from OFF position applies vacuum to the vacuum diaphragm controlling the outside air door, and closes a switch in the blower circuit. Further movement of the lever opens the temperature door and manual gate water valve.

2. DEFROSTER Control Lever—This lever regulates the positioning of the defroster door. In addition, similar to the HEATER TEMP control, the lever also opens the outside air door and closes a switch in the blower circuit. Initial movement of the lever just past OFF position applies vacuum to the outside air door vacuum diaphragm and closes one of the blower circuit switches. Further movement of the lever opens the defroster door.

3. BLOWER Switch Control - This control operates a three position blower switch. First, second and third positions of lever respectively provide low, medium, and high blower speeds.

NOTE: For blower motor operation both switches (the switch controlled jointly by the HEATER TEMP and DEFROSTER control levers, and the switch controlled by the BLOWER lever) must be closed.

11-7 SERVICING HEATER SYSTEM COMPONENTS (4400-4600 AND 4800 SERIES)

a. Air, Temperature, Defroster and Rear Control Wire Adjustment

The air, temperature, defroster and rear control wires (see Figure 11-31) are all adjusted by means of adjuster nuts. To gain access to the adjuster nuts remove the glove box from instrument panel. Adjust position of control lever to full off and rotate adjuster nut until lever knobs are in line and lever has approximately 1/8 inch springback from full off position. Work lever thru travel several times and recheck for proper adjustment.

NOTE: When adjusting the air control wire, the manual gate water valve control wire should be disconnected. To install water valve control wire refer to subparagraph "b".

b. Manual Gate Water Valve Control Wire Installation

1. Position TEMP control lever and lever of manual gate water valve to full off.

NOTE: To set water valve to closed position--rotate lever in a clockwise direction until it touches pipe. TEMP control lever should have 1/8 inch springback (ref. subpar. "a") before installing wire.

2. Attach control wire to water valve lever and temperature door lever and secure in position. Work TEMP lever thru its travel several times and recheck for approximately 1/8 inch springback action, and to insure no binding action exists.

c. Heater Door Control Assembly Adjustment

The following adjustment is recommended if there is not full travel of the AIR control lever, or if the heater door control assembly is removed.

1. Position AIR control lever on instrument panel to full on.

2. Remove top cover (see Figure 11-36) from heater door control assembly and disconnect air control wire.

3. Loosen screws securing control assembly to blower and air inlet assembly and reposition control assembly so that lever of outside air door is fully open.

NOTE: To open outside air door, the door lever should be rotated in a clockwise direction.

When making adjustment be sure lever of heater door control assembly is fully extended.

4. Secure control assembly in position and reassemble air control wire to assembly.

5. Readjust air control wire as necessary (ref. subpar. "a").

6. Reassemble heater door control assembly and seal edges with body sealer.

d. Removal of Heater System Components

To remove heater core it is necessary to take out heater assembly. Removal of all components of heater system will be obvious on inspection (see Figures 11-42 and 11-43).

NOTE: Removal of two screws (see Figure 11-42) securing blower and air inlet assembly to cowl may be facilitated by taking off of hood right-hand hinge, and also right fender skirt antenna access hole cover (see Figure 11-9).

e. Right Vent and Left Vent Control Wire Adjustment

To adjust vent controls (see Figure 11-44), set vent knob 1/8 inch from full off position, fully close vent door and secure control wire sheath in position. To gain access to control wire clamp remove floor kick pads.

11-8 SERVICING HEATER SYSTEM COMPONENTS (4700 SERIES)

a. Heater Temperature and Defroster Control Wire Adjustment

The heater temperature and defroster levers are adjusted by means of adjuster nuts on the control wires (see Figure 11-45). To gain access to adjuster nuts remove three screws securing console left trim panel to center console and take out trim panel. Adjust control levers to full off and rotate adjuster nuts until lever knobs are in line and approximately 1/8 inch springback exists. Work lever back and forth several times and recheck for proper adjustment.

NOTE: When adjusting the heater temperature control wire, disconnect the control wire linking the manual gate water valve and the bottom lever of the temperature door (see Figure 11-39).

b. Manual Gate Water Valve Control Wire Installation

Position TEMP control lever and lever of manual gate water valve to full off.

NOTE: TEMP control lever should have 1/8 inch springback (Ref. subpar. "a"). To set water valve to closed position - rotate lever in a clockwise direction until it touches pipe.

Attach control wire to water valve lever and temperature door lever and secure in position. Work TEMP lever thru its travel several times and recheck for approximately 1/8 inch springback action, and to insure no binding action exists.

c. Removal of Heater System Components

To remove heater core it is necessary to take out heater assembly. Removal of all components of heater system will be obvious on inspection (see Figures 11-37, 11-38, and 11-46).

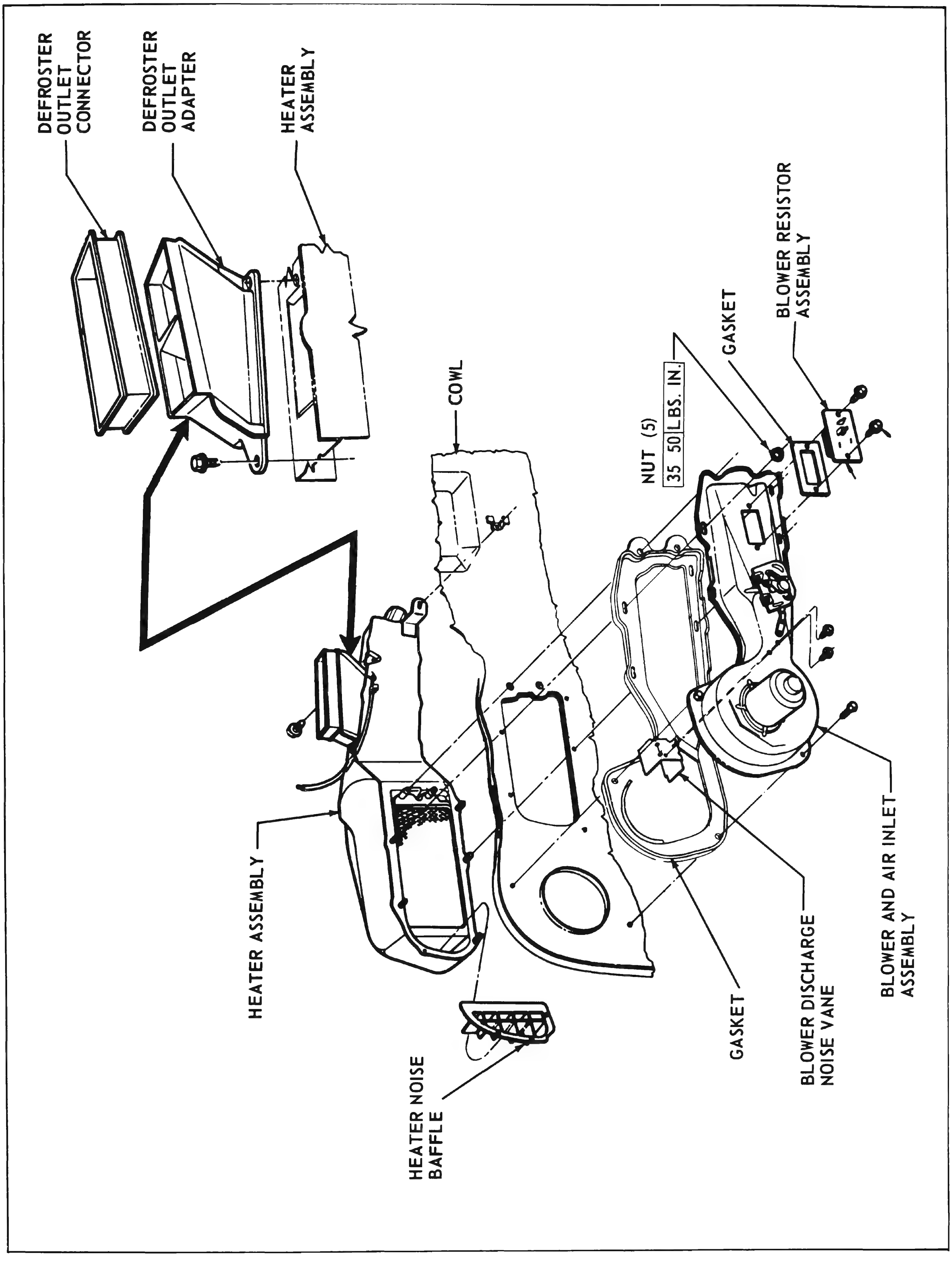


Figure 11-42—Heater System Installation - 4400, 4600 and 4800 Series

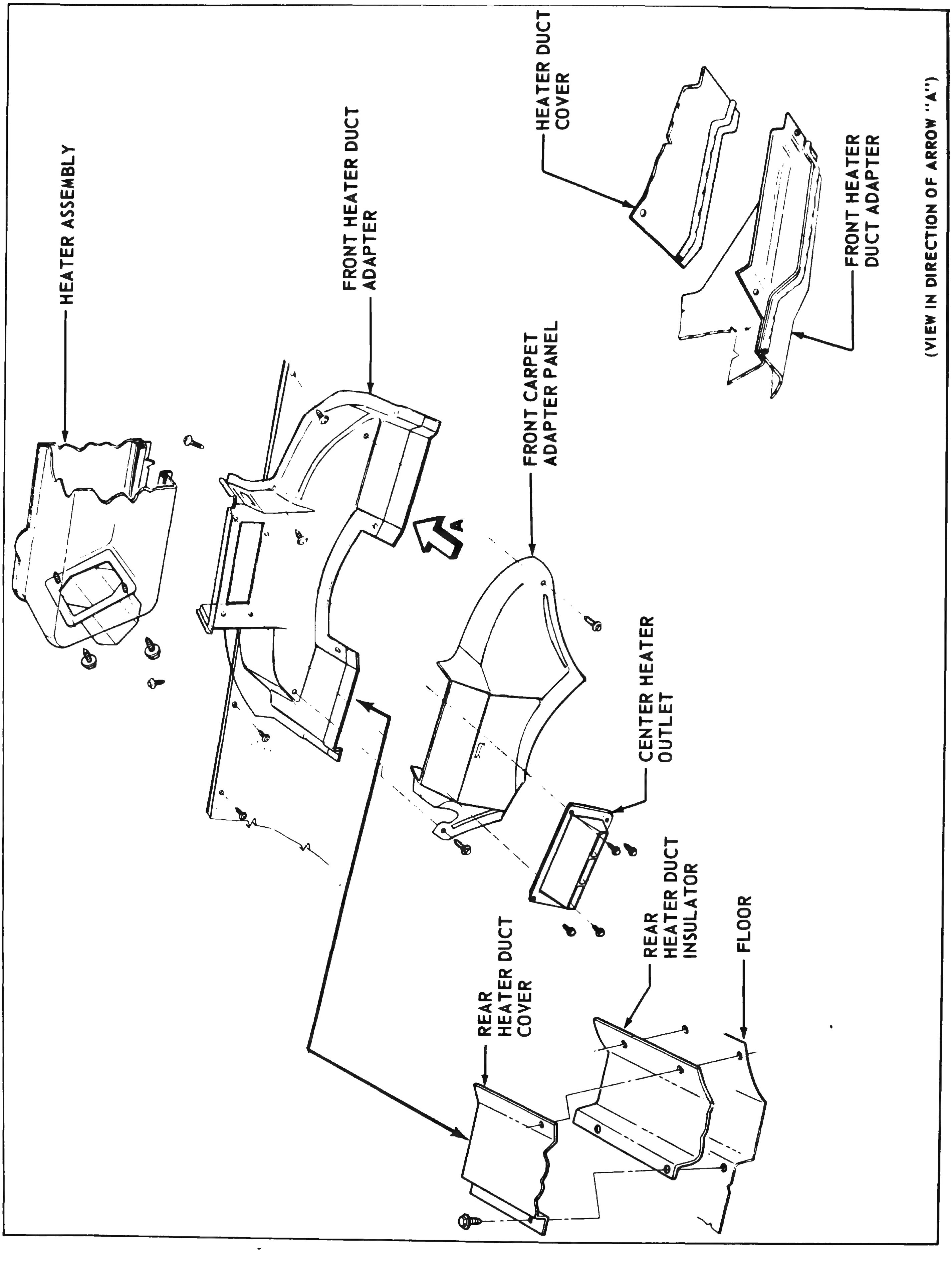


Figure 11-43—Heater System Installation - 4400, 4600 and 4800 Series

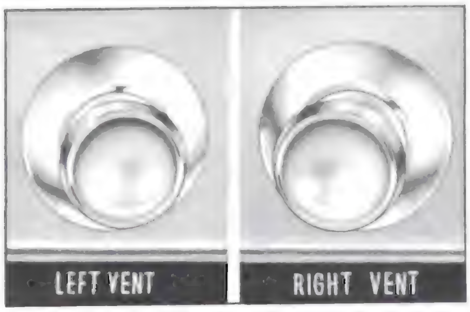


Figure 11-44—Vent Controls - 4400, 4600 and 4800 Series

d. Left and Right Vent Control Wire Adjustment

To adjust vent controls (see Figure 11-41) remove three screws and take out console left trim panel (see Figure 11-45). Rotate vent control wire adjuster nuts to obtain 1/8 inch springback when lever in full off position.

11-9 HEATER SYSTEM TROUBLE DIAGNOSIS

NOTE: It is suggested that prior to inspecting a car for heater system malfunctions, the owner be checked to determine if system is being operated correctly. All windows and vents must be closed to effect maximum heat buildup.

TROUBLE	CORRECTION
4400, 4600 & 4800 Series	
1. Blower motor inoperative.	1a. Check fuse. . 1b. Check for defective heater blower switch (see Figure 11-36). 1c. Check motor ground wire (see Figure 11-32). 1d. Check for defective blower resistor assembly (see Figure 11-32). 1e. Check for loose connectors or broken wires.
2. Insufficient heating.	2a. Check operation of outside air door (ref. subpar. 11-7, "a" and "c"), temperature door, and rear heat door to insure full opening and closing. 2b. Check for air leaks around sealing edges of components. 2c. Check for insufficient coolant.
3. Inadequate defrosting.	3a. Check operation of outside air door (ref. subpar. 11-7, "a" and "c"), temperature door or defroster door. 3b. Also refer to above corrections 2b and 2c.
4700 Series	
4. Blower motor inoperative.	4a. Check fuse. 4b. Check for defective heater blower switches (2) located on heater-defroster control assembly. 4c. Check blower motor ground wire (see Figure 11-39). 4d. Check for defective blower resistor assembly (see Figure 11-37). 4e. Check for loose connections or broken wires.
5. Insufficient heating.	5a. Check operation of outside air door (ref. subpar. 11-6, "b"), and temperature door (ref. subpar. 11-8, "a"). 5b. Also refer to above corrections 2b and 2c.
6. Insufficient defrosting.	6a. Refer to correction 5a. 6b. Check operation of defroster door (ref. subpar. 11-8 "a").

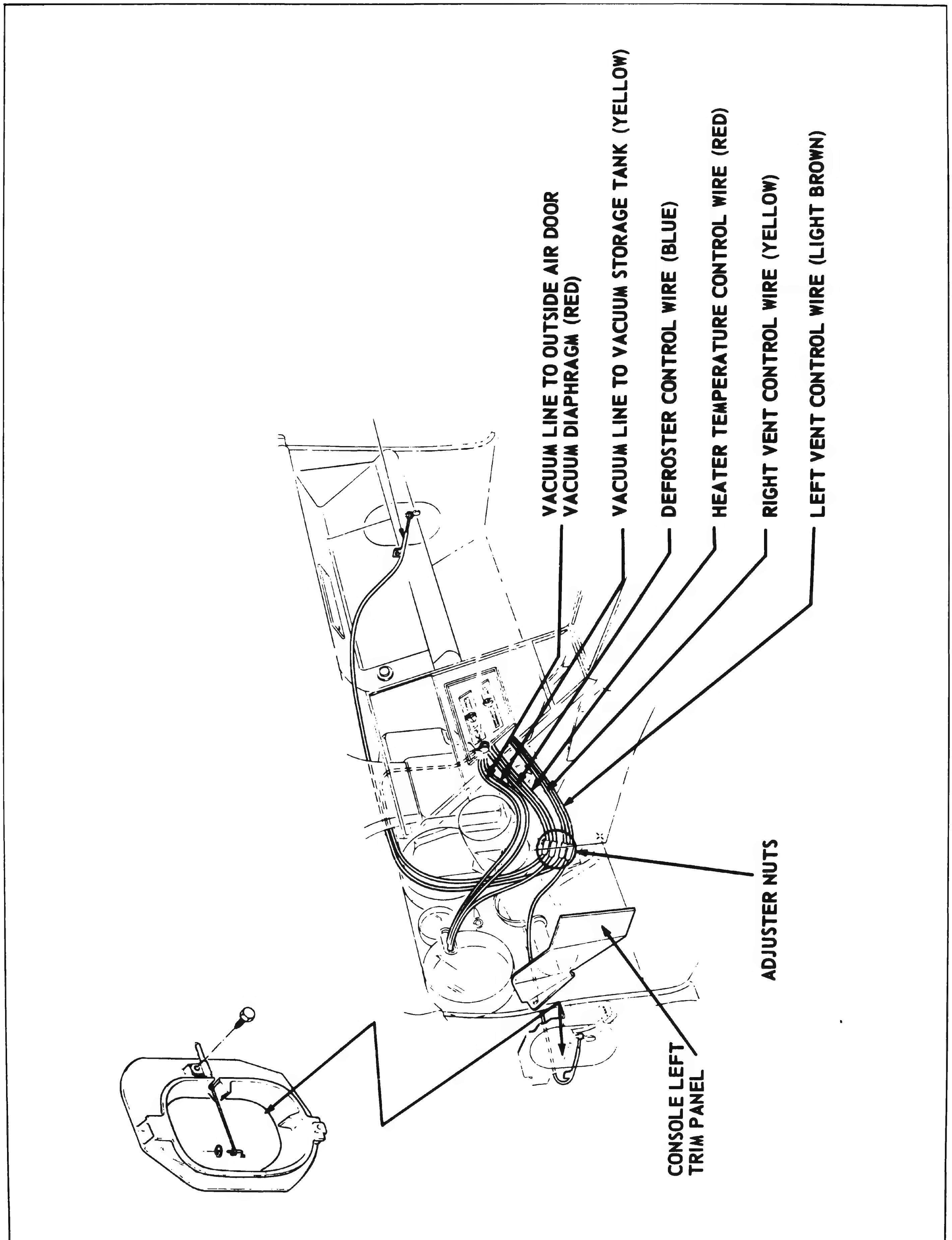


Figure 11-45—Heater System Control Wires - 4700 Series

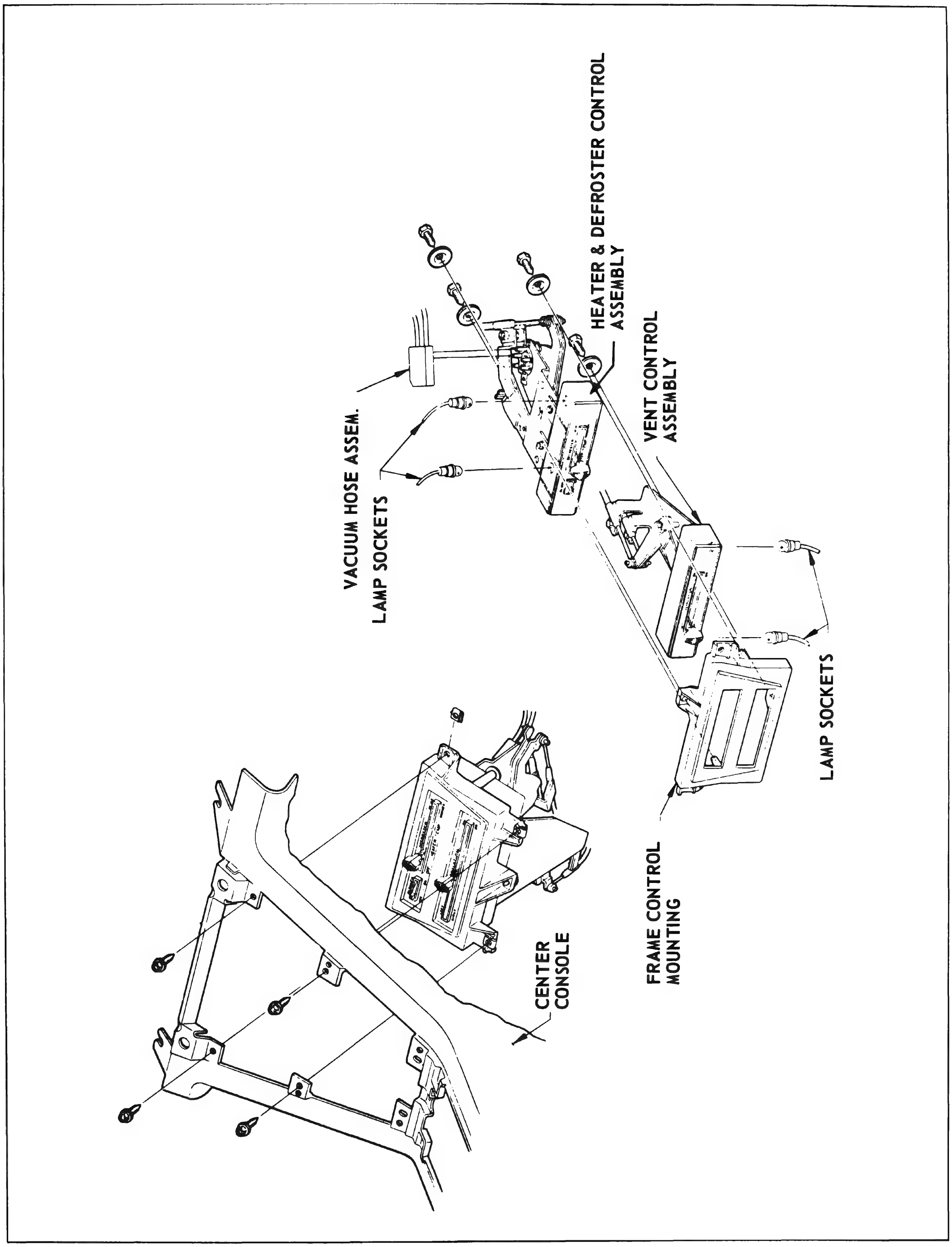


Figure 11-46—Heater and Defroster, and Vent Control Assemblies Installation - 4700 Series

SECTION 11-C

OPTIONAL HEATER-AIR CONDITIONER SYSTEM

CONTENTS OF SECTION 11-C

11-10 SPECIFICATIONS

a. Tighening Specifications

Part	Location	Ft. Lbs.
Nut	Drive Plate Nut to Compressor Shaft	14-16
Nut	Compressor Rear Head to Shell	19-23
Cap	Schrader Service Valve	4-5

For compressor mounting bracket bolts see Figures 11-92 and 11-93.

Metal Tube Outside Diameter	Thread and Fitting Size	Steel Tubing Torque Lb.-Ft.	Aluminum or Copper Tubing Torque Lb.-Ft.	Nominal Torque Wrench Span
1/4	7/16	10-15	5-7	5/8
3/8	5/8	30-35	11-13	3/4
1/2	3/4	30-35	11-13	7/8
5/8	7/8	30-35	18-21	1 1/16
3/4	1 1/16	30-35	23-28	1 1/4

If a connection is made with steel to aluminum or copper, use torques for aluminum. In other words, use the lower torque specification.

Use steel torques only when both ends of connection are steel.

Figure 11-47—Pipe and Hose Connection Torque Chart

b. Compressor Specifications

Type	Six Cylinder Axial
Make	Frigidaire
Displacement - (cu. in.)	12.6

b. Compressor Specifications

Oil	Frigidaire 525 Viscosity
Oil Content (New)	10-1/2 oz. Fluid
Internal Clearances	See Figure 11-65
Air Gap Between Clutch Drive Plate and Pulley	.022" to .057"
Clutch Type	Magnetic
Belt Tension	See Figures 2-47 and 2-48

c. Miscellaneous

Refrigerant	Freon 12, Ucon 12, Genetron 12, Isotron 12
System Capacity (Fulley Charged)	4400-4600-4800 4 lbs.
	4700 3 1/2 lbs.
Blower Motor Fuse	30 Amp. Located on Fuse Block
Type of Temperature Control	Suction Throttle Valve

11-11 DESCRIPTION AND OPERATION OF OPTIONAL HEATER-AIR CONDITIONER SYSTEM

a. 4400, 4600 and 4800 Series

The heater-air conditioner system for the 4400, 4600 and 4800 Series cars is a series type, air mix system. The air flows thru the evaporator core, and then may either flow thru, around, or both thru and around the heater core. This arrangement affords the driver with the advantage of being able to cool the air (to dehumidify) and reheat the air as may be required on cool, damp days. The temperature of the air is controlled by regulation of the mixture between hot and cold air. A manual water valve is provided to control the flow of coolant to the heater core.

To operate the heater the CLIMATE control (ref. par. 11-13, see Figure 11-71) must be in the HEAT position. The four levers (AIR, TEMP, DEFR, AND REAR) will operate the same as on the non-air conditioned heater system. The heater portion of the system also has the same AIR, TEMP, DEFR, AND REAR control wire adjustments as on the non-air conditioned heater system (ref. par. 11-15). The AIR control wire connects to the blower and circuit control assembly mounted under the instrument panel on the heater case. The TEMP control wire attaches to the temperature door in the heater assembly. A second control wire runs from the temperature door to the manual water valve located on the right fender skirt. Thus, the initial movement of the TEMP lever from off fully, opens the water valve and also proportionately opens the temperature door to allow some air to pass thru the heater core. Further movement of the TEMP lever only serves to further open the temperature door.

b. 4700 Series

The 4700 Series heater-air conditioner system is an air mix type system; however, the air ducts are situated such that the air flow for air conditioning and the air flow for heating are entirely separate. The temperature of the heated air is controlled by regulation of the mixture of hot and cold air. The heater portion of the heater-air conditioner system for 4700 Series cars is the same heater used for non-air conditioned cars. For further information pertaining to the heater system refer to Section 11-B.

c. Both Systems, 4400-4600-4800 Series and 4700 Series

Both the 4400, 4600 and 4800 Series system and the 4700 Series system are similar in that the same blower is used to force air thru the air conditioner ducts and/or the heater ducts simultaneously. In addition, the refrigerating components of the heater-air conditioner system are all located in the engine compartment. They are namely the (1) compressor, (2) condenser, (3) receiver-dehydrator, (4) evaporator, (5) suction throttle valve, (6) expansion valve, and (7) muffler (see figures 11-48 and 11-49).

A larger capacity radiator and fan to increase cooling system efficiently are included on all factory equipped cars with air conditioner. Also, a fan clutch is used.

Air conditioner equipped cars have the fuel vapor by-pass system. This consists of a special fuel filter and fuel return lines which allow a constant flow of fuel from gas tank to filter and back to tank. This reduces the possibility of vapor lock when operating in extremely hot weather.

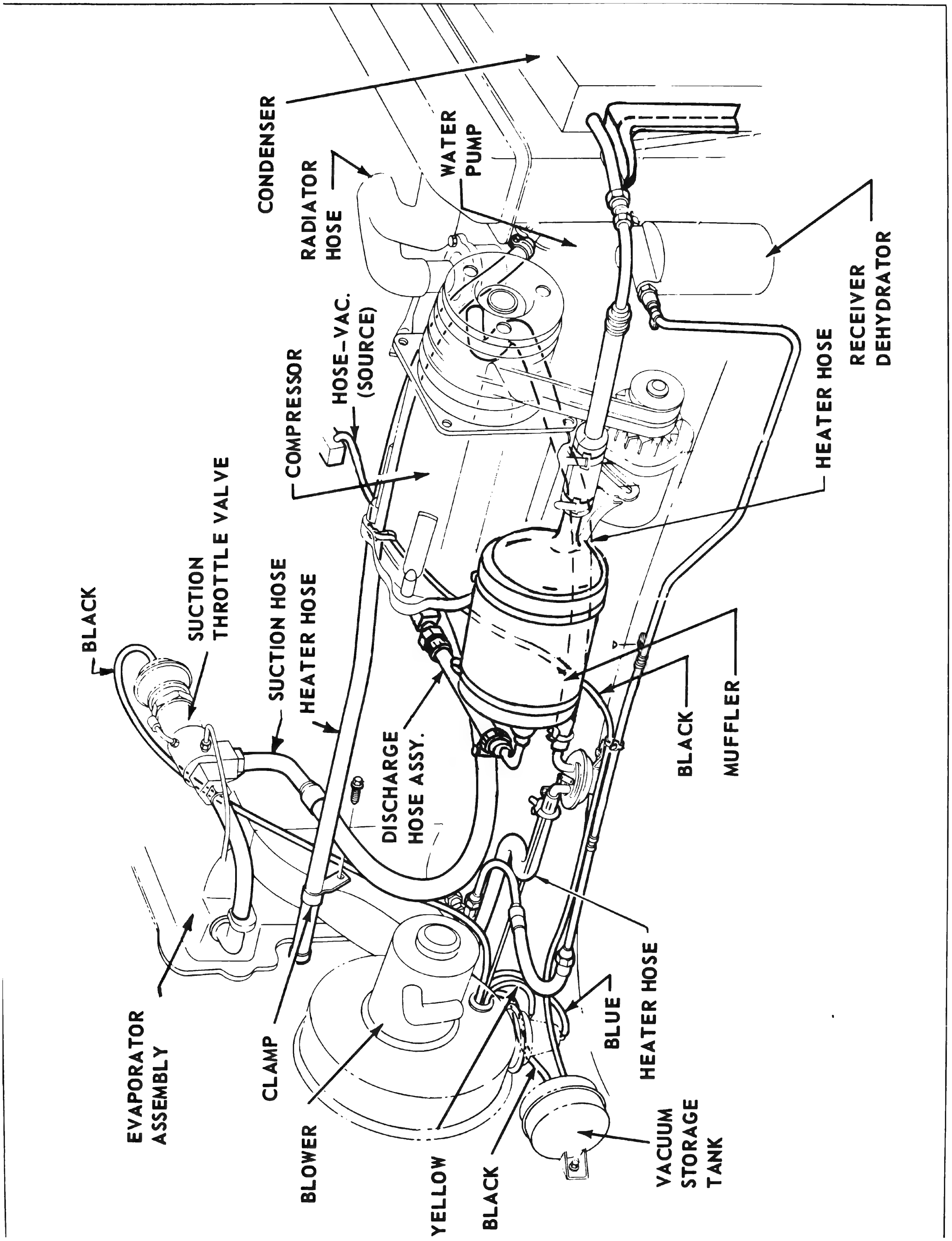


Figure 11-48—Air Conditioner Installation - 4400, 4600 and 4800 Series

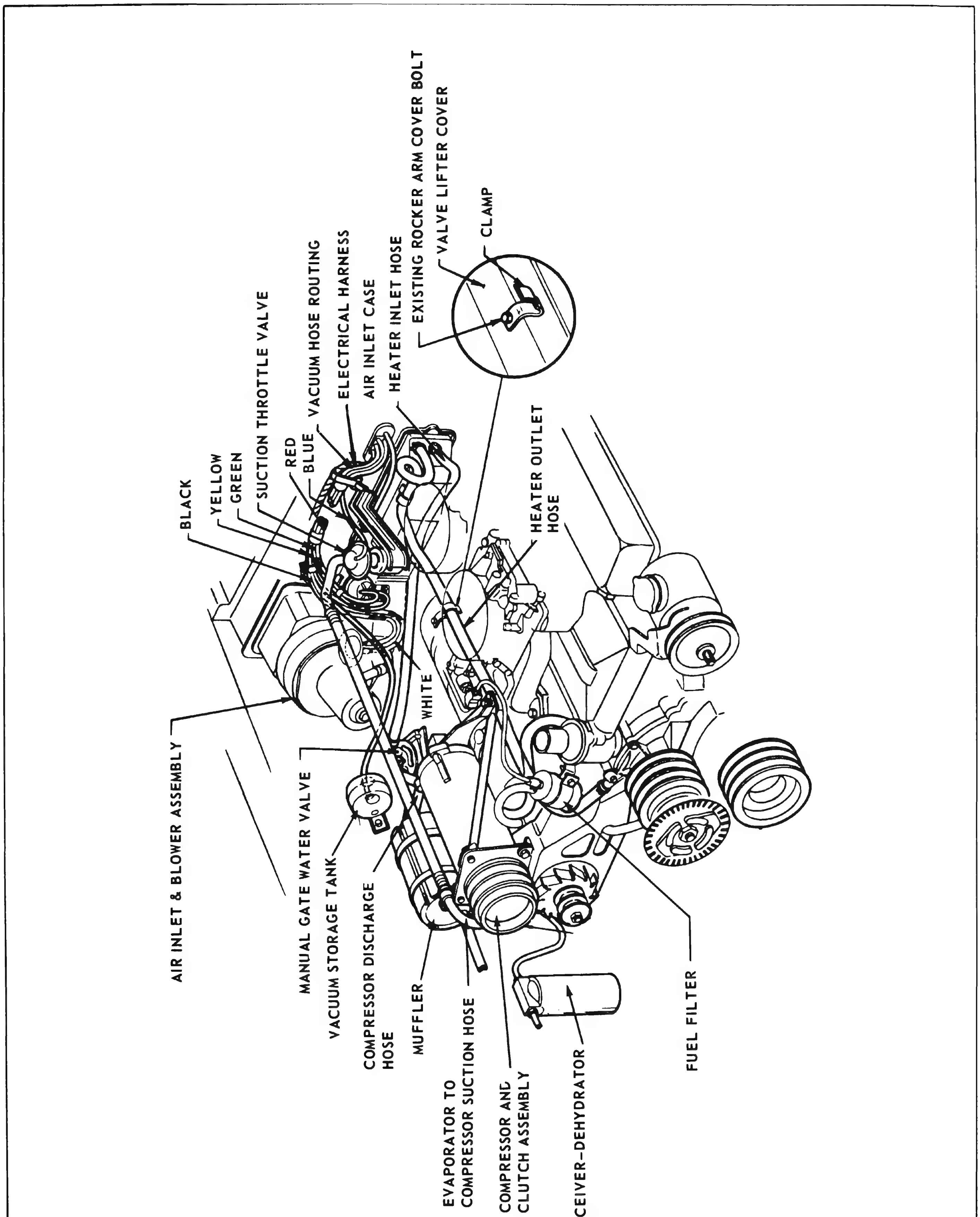


Figure 11-49—Air Conditioner Installation - 4700 Series

Any service work that requires loosening a refrigerant line connection should be performed only by qualified service personnel who have attended either Buick or other automotive air conditioner training schools. Whenever a hose or pipe is disconnected from any unit, refrigerant will escape. Any work involving the handling of refrigerants requires special equipment and a knowledge of its proper use.

The air conditioner uses Schrader valve fittings instead of shut-off service valves; therefore, whenever a part is removed that is in the refrigeration circuit or a line disconnected, the refrigerant must be discharged from system as described in paragraph 11-15, "c".

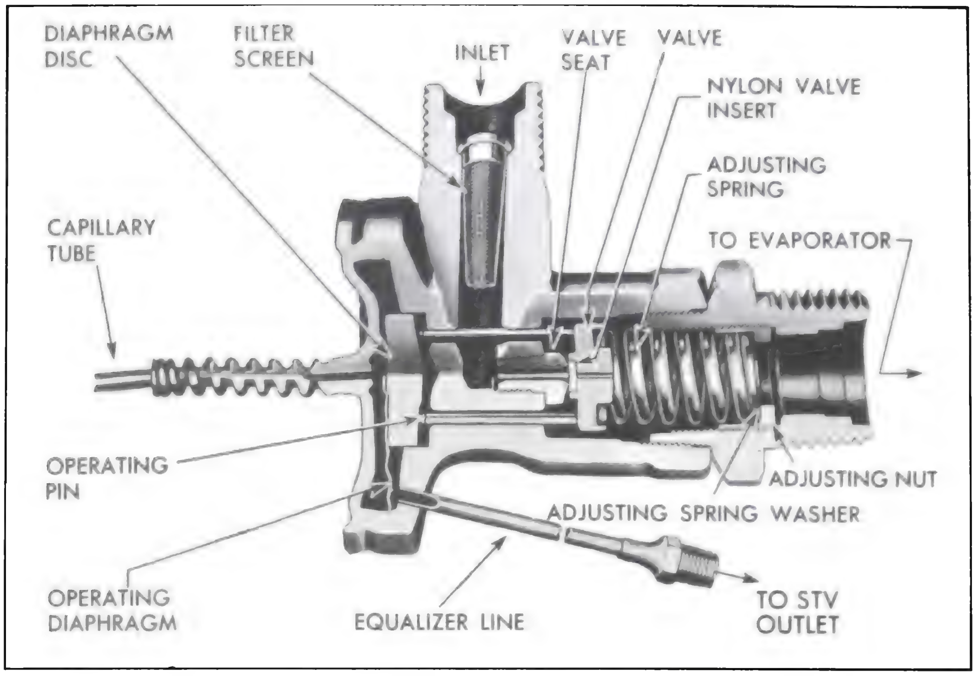


Figure 11-50—Expansion Valve

d. Description of Components

NOTE: See paragraph 11-12 for description of compressor.

1. Hoses. The connecting elements are made from a high temperature, high pressure synthetic rubber hose with double cord reinforcements. The hose ends are fitted with O-ring fittings.

2. Schrader Service Valves. Two Schrader service valves are used on the air conditioner for evacuating and charging the system. The valve located on the compressor discharge line at rear of compressor, also is used for checking compressor head or discharge pressures. The low pressure valve located on the suction throttle valve is also used for checking evaporator pressure when functional testing system or adjusting suction throttle valve.

3. Condenser. The condenser is similar to the ordinary car radiator but is designed to withstand much higher pressures. The condenser used on all series is of aluminum construction. The condenser is mounted in front of the radiator so that it receives a high volume of air. Air passing over the condenser cools the hot high pressure refrigerant gas, causing it to condense into high pressure liquid refrigerant.

4. Receiver-Dehydrator. The receiver-dehydrator is located at the right front of engine compartment. A liquid indicator or sight glass is an integral part of the outlet pipe of the receiver-dehydrator. The sight glass serves as an aid to diagnosis. The appearance of bubbles or foam beneath the sight glass when ambient temperature is higher than 70°F indicates air or a shortage of refrigerant in the system.

CAUTION: Continuous bubbles may appear in a properly charged system on a cool day. This may be considered normal if temperature of surrounding air is low.

The purpose of the receiver part of assembly is to insure a solid column of liquid refrigerant to the expansion valve at all times, provided the system is properly charged. The dehydrator part of assembly functions to absorb any moisture that might be present in system after assembly. Also, it traps foreign material which may have entered system during assembly.

NOTE: IN and OUT are stamped on receiver. IN attaches to condenser and OUT to liquid line.

5. Expansion Valve. The expansion valve is located at the inlet to the evaporator core.

The expansion valve consists of a capillary bulb and tube which is connected to an operating diaphgram sealed within the valve itself, and an equalizer line which connects the valve with the suction throttling valve outlet pressure. See Figure 11-50.

The valve contains three operating pins, valve stationary seat, valve, valve carriage, adjusting spring and screw, an inlet which has a fine mesh screen, and an outlet connection (which attaches to the evaporator). The fine mesh screen at the inlet of the valve provides protection to the valve by preventing dirt and other foreign material from entering the valve.

While this valve is located at the inlet of the evaporator, the

thermo bulb is attached to the evaporator outlet pipe.

The equalizer line joins the expansion valve to the suction throttle valve outlet so that this pressure will register in the expansion valve.

The purpose of the expansion valve is to regulate the flow of liquid refrigerant into the evaporator automatically in accordance to the requirements of the evaporator.

This valve is the dividing point in the system between high pressure liquid refrigerant supplied from the receiver and relatively low pressure liquid and gaseous refrigerant in the evaporator. It is so designed that the temperature of the refrigerant at the evaporator outlet must have 6° F. of superheat before more refrigerant is allowed to enter the evaporator. Superheat is an increase in temperature of the gaseous refrigerant above the temperature at which the refrigerant vaporized.

NOTE: The superheat setting on the 4700 expansion valve is 10° F. For explanation purposes, the 6° F setting of the 4400, 4600 and 4800 will be used.

A capillary tube filled with carbon dioxide and the equalizer line provide the temperature regulation of the expansion valve. This capillary tube is fastened to the low pressure refrigerant pipe coming out of the evaporator so that it communicates the temperature of the refrigerant at this point to the expansion valve. If the temperature differential between the inlet and outlet decreases below 6° F., the expansion valve will automatically reduce the amount of refrigerant entering the evaporator.

If the temperature differential increases, the expansion valve will automatically allow more refrigerant to enter the evaporator. It is the temperature of the air passing over the evaporator core that determines the amount of refrigerant that will enter and pass through the evaporator. When the air is very warm, the heat transfer from the air to the refrigerant is great and a greater quantity of refrigerant is required to cool the air and to achieve the proper superheat on the refrigerant gas leaving the evaporator. When the air passing over the evaporator is cool, the heat transfer is small and a lesser quantity of refrigerant is required to cool the air and to achieve the proper superheat on the refrigerant gas leaving the evaporator.

A mechanical adjusting nut located within the valve is provided to regulate the amount of refrigerant flow through the valve; when turned, move the spring seat to increase or decrease the tension on the needle valve carriage spring. By varying the tension on this spring, it is possible to regulate the point at which the needle valve begins to open or close, thereby regulating refrigerant flow into the evaporator. As this adjustment feature is inside the valve, no external adjustment is possible. All expansion valves are preset at the time of manufacture.

When the air conditioning system has not been operating, all pressure within the expansion valve assembly will have equalized at the ambient (surrounding air) temperature, thus the pressure above and below the operating diaphragm and at the inlet and outlet side of the valve will be equal. (Pressure under the diaphragm is evaporator presssure. It reaches this area by means of clearance around the operating pins which connects the area under the diaphragm with the evaporator pressure area.) While pressures in the expansion valve are almost equal, the addition of the valve adjusting spring pressure behind the needle will hold the needle valve over to close the needle valve orifice.

When the air conditioning system first begins to operate, the compressor will immediately begin to draw refrigerant from the evaporator and in the area under the operating diaphragm. As the pressure in this area decreases, the pressure above the diaphragm exerted by the carbon dioxide in the capillary tube will overcome spring pressure and push the diaphragm against the operating pins, which in turn will force the needle off its seat.

Refrigerant will then pass through the expansion valve into the evaporator where it will boil at a temperature corresponding to the pressure in the evaporator. This will begin cooling the air passing over the evaporator, and, also it will begin to cool the evaporator outlet pipe.

The valve adjusting spring is calibrated so that the pressure of the refrigerant in the evaporator outlet pipe and equalizer line to the valve, plus the spring force, will equal the force above the operating diaphragm when the temperature of the refrigerant in the evaporator outlet is 6° F. above the temperature of the refrigerant entering the evaporator. In other words, the refrigerant should remain in the evaporator long enough to completely vaporize and then warm (superheat) 6° F.

If the temperature differential begins to go below 6° F. (outlet pipe becoming too cold) carbon dioxide pressure in the capillary tube and area above the diaphragm decreases, allowing the valve adjusting spring to move the needle valve towards its seat closing off the flow of refrigerant past the needle valve.

If the temperature differential begins to go above 6° F. (outlet pipe too warm), the pressure in the capillary tube and area above the

operation diaphragm will increase, pushing this diaphragm against the operating pins to open the needle valve further, admitthe needle valve further, admitting more refrigerant to the evaporator.

The equalizer line permits the STV outlet pressure to be imposed on the expansion valve diaphragm, thus, over-riding its normal control of liquid refrigerant. As the compressor capacity becomes greater than the evaporator load, the drop in compressor suction line pressure forces the expansion valve to flood liquid through the evaporator and STV, thus preventing the suction pressure from dropping below a predetermined pressure.

The equalizer line is used primarily to prevent prolonged and constant operation of the compressor in vacuum conditions. This operation is considered undesirable both from a noise angle and from possibility of subjecting the compressor to reduced oil return. Additional considerations for having the external equalized expansion valve are to maintain a full evaporator during throttling, and also guard against noncondensibles entering the system, especially through loosened fittings.

6. Evaporator. The evaporator core on the 4400, 4600 and 4800 Series is of plate type design and is located near the center of the cowl in the engine compartment. The 4700 Series evaporator is of the tube and fin (Series) design and is located under the right side of the instrument panel.

The purpose of the evaporator core is to cool and dehumidify the air that is flowing through it when the system air conditioner is in operation. High pressure liquid refrigerant flows through the orifice in the expansion valve into the low pressure area of the evaporator. This regulated flow of refrigerant boils immediately. Heat from the core surface is lost thru boiling and vaporizing of the refrigerant which is cooler than the core, thereby cooling the core. The air passing over the evaporator loses its heat to the cooler surface of the core. As the process of heat loss from the air to the evaporator core surface is taking place, moisture in the air condenses on the outside surface of the evaporator core and is drained off.

Since Refrigerant-12 will boil at 21.7°F. below zero at atmospheric pressure (see Figure 11-51) while water freezes at 32° F., it becomes obvious that the temperature in the evaporator must be controlled so that the water collecting on the core surface will not freeze in the fins of the core and block off the air passages. In order to control the temperature, it is necessary to control the amount of refrigerant entering the core and the pressure inside the evaporator.

To obtain maximum cooling, the refrigerant must remain in the core long enough to completely vaporize and then superheat a minimum of 6° F. If too much or too little refrigerant is present in the core, then maximum cooling efficiency is lost. The expansion valve in conjunction with the suction throttling valve is used to provide this necessary refrigerant volume control.

An oil bleed line is connected from the bottom of the evaporator to the outlet side (compressor suction) of the suction throttle valve. This bleed line is connected to a check valve on the suction throttle valve. The check valve is a special low force spring valve core.

The bleed line is in the system as an insurance measure to provide increased compressor life during times of low refrigerant charge. During normal-charge conditions this line is of no particular benefit as the compressor runs on an

REFRIGERANT-12
PRESSURE-TEMPERATURE RELATIONSHIP

The table below indicates the pressure of Refrigerant-12 at various temperatures. For instance, a drum of Refrigerant at a temperature of 80°F. will have a pressure of 84.1 psi. If it is heated to 125°F. the pressure will increase to 167.5 psi. It also can be used conversely to determine the temperature at which Refrigerant-12 boils under various pressures. For example, at a pressure of 30.1 psi, Refrigerant boils at 32°F.

TEMP (°F.)	PRESSURE (PSIG)	TEMP. (°F.)	PRESSURE (PSIG)
-21.7	0 (atmospheric pressure)	55	52.0
		60	57.7
-20	2.4	65	63.7
-10	4.5	70	70.1
- 5	6.8	75	76.9
0	9.2	80	84.1
5	11.8	85	91.7
10	14.7	90	99.6
15	17.7	95	108.1
20	21.1	100	116.9
25	24.6	105	126.2
30	28.5	110	136.0
32	30.1	115	146.5
35	32.6	120	157.1
40	37.0	125	167.5
45	41.7	130	179.0
50	46.7	140	204.5

Figure 11-51—Pressure and Temperature Relationship of Refrigerant-12

adequate oil supply. With partially depleted refrigerant charge, oil and refrigerant mixture will flow from the bottom tank of the evaporator through the oil bleed line to the compressor. This oil flow helps to prevent oil deficiencies in the compressor that could arise under these conditions. During times of zero-change no refrigerant will be available to carry oil back to the compressor. It is therefore important that completely discharged systems be kept to a minimum of operation, thus preventing seizure.

The bleed line's check valve in the STV opens at 5 psi differential pressure between the evaporator inlet pressure and the STV outlet pressure. This check valve is fully open when these two pressures exceed 12 psi differential. Below the 5 psi differential, the check valve will be closed to prevent refrigerant and oil from flowing out the bottom of the evaporator. This feature prevents refrigerant cooling capacity losses within the evaporator as may occur when driving thru heavy traffic when cooling demands are greatest on the system due to low rpm of the engine.

At all times when the compressor capacity (evaporator inlet pressure) exceeds the evaporator load demands by 5 psi or greater, this valve starts to open. It then permits refrigerant and oil to flow from the evaporator bottom tank to the inlet of the compressor.

7. Suction Throttle Valve. Two different suction throttle valves are used. One for the 4400, 4600 and 4800 air conditioner and one for the 4700 air conditioner. The difference between these two valves is the method of controlling the setting of the valve for less cooling.

The 4400, 4600 and 4800 has a two position suction throttle valve which obtains the maximum cooling setting by applying vacuum to its vacuum diaphragm. For setting this valve for less cooling, the vacuum is exhausted from the diaphragm.

The 4700 suction throttle valve has a vacuum diaphragm of different construction. Maximum cooling is obtained when vacuum is not applied to the diaphragm. A vacuum modulator is used with the 4700 suction throttle valve to vary the vacuum to the diaphragm from 0 to 6-1/2 inches and set it at a higher setting (less cooling). The greater the vacuum present in the diaphragm (up to 6-1/2 inches) the higher the air conditioner outlet temperature.

The suction throttle valve (STV) controls the evaporator pressure and in turn the evaporator air outlet temperature. Also the STV prevents freezing of the condensation on the evaporator core surface. The STV consists of a valve body, piston, piston diaphragm, control spring, diaphragm cover, diaphragm cap and vacuum diaphragm. See Figures 11-52 and 11-53.

The inside of the piston is hollow and is open to the piston diaphragm by small holes in the end of the piston. Located in the lower extremity of the piston is a fine mesh screen, held in place by a retainer. The purpose of this screen is to prevent any foreign particle of any substance entering the piston and lodging in the holes drilled in the piston wall and possibly scoring the surface of the body, thus interfering with its proper operation.

The piston diaphragm retains the piston to it by a tab on the front side and has the cup held against it by the spring on the rear side. The vacuum diaphragm actuating pin fits in the end of the cup. The body of the vacuum diaphragm threads into the valve cover and determines the amount of spring tension on the cup. The vacuum diaphragm is locked in position by a locknut.

On the 4700 Series, the suction throttling valve vacuum diaphragm is connected to the vacuum modulator on the instrument panel by a small hose. When vacuum is present on the diaphragm, it is pulled toward the piston and its pin adds to the spring pressure on the piston diaphragm.

The vacuum diaphragm on the 4400, 4600 and 4800 suction throttle valve is connected to a vacuum switch which is operated by the TEMP lever. The vacuum diaphragm has a spring inside of it. See Figure 11-52. This spring adds to the pressure of the large spring located in the cover when vacuum <u>is not</u> present in diaphragm. When vacuum is applied, the vacuum diaphragm compresses the spring inside it and the spring tension is reduced on the piston diaphragm.

The STV inlet is connected to the evaporator outlet and its outlet is connected to the compressor suction port. See Figure 11-52.

The flow of the low pressure vapor from the evaporator to the compressor is determined and controlled by the position of the piston in the valve body of the STV. The position of the piston in the body is determined by the balance of the forces that are applied to the piston diaphragm. These forces consist of the refrigerant vapor pressure returning from the evaporator on one side and th spring tension, plus the force of the actuating pin on the other side. (The actuating pin adds or subtracts to the spring pressure.) Movement of the piston permits vapor to pass around piston and then on to the compressor inlet.

During the time that maximum cooling is being produced, the STV vacuum diaphragm on the 4700 does not have vacuum applied to it, while the 4400, 4600 and 4800 vacuum diaphragm has at least 4-1/2 inches of vacuum applied to it. The full flow of low pressure refrigerant vapor is being returned to the compressor to permit it to exert its full capacity on the evaporator and produce maximum cooling. Under most operating conditions, STV inlet and outlet pressures will not be the same as there will be some throttling to prevent evaporator icing.

When the operator desires to raise the temperature within the car, the controls are changed to apply engine vacuum to the 4700 Series STV vacuum diaphragm. On the 4400, 4600 and 4800, the vacuum is exhausted from the vacuum diaphragm. This checks or throttles the flow of the low pressure vapor returning to the compressor. This results in a higher pressure to be maintained in the evaporator assembly. The STV outlet pressure will also increase, but the differential between STV inlet and outlet will be greater than when STV is at maximum cooling.

(a) Maximum cooling setting of 4700 STV -- The maximum cooling setting of the 4700 STV is obtained when there is no vacuum

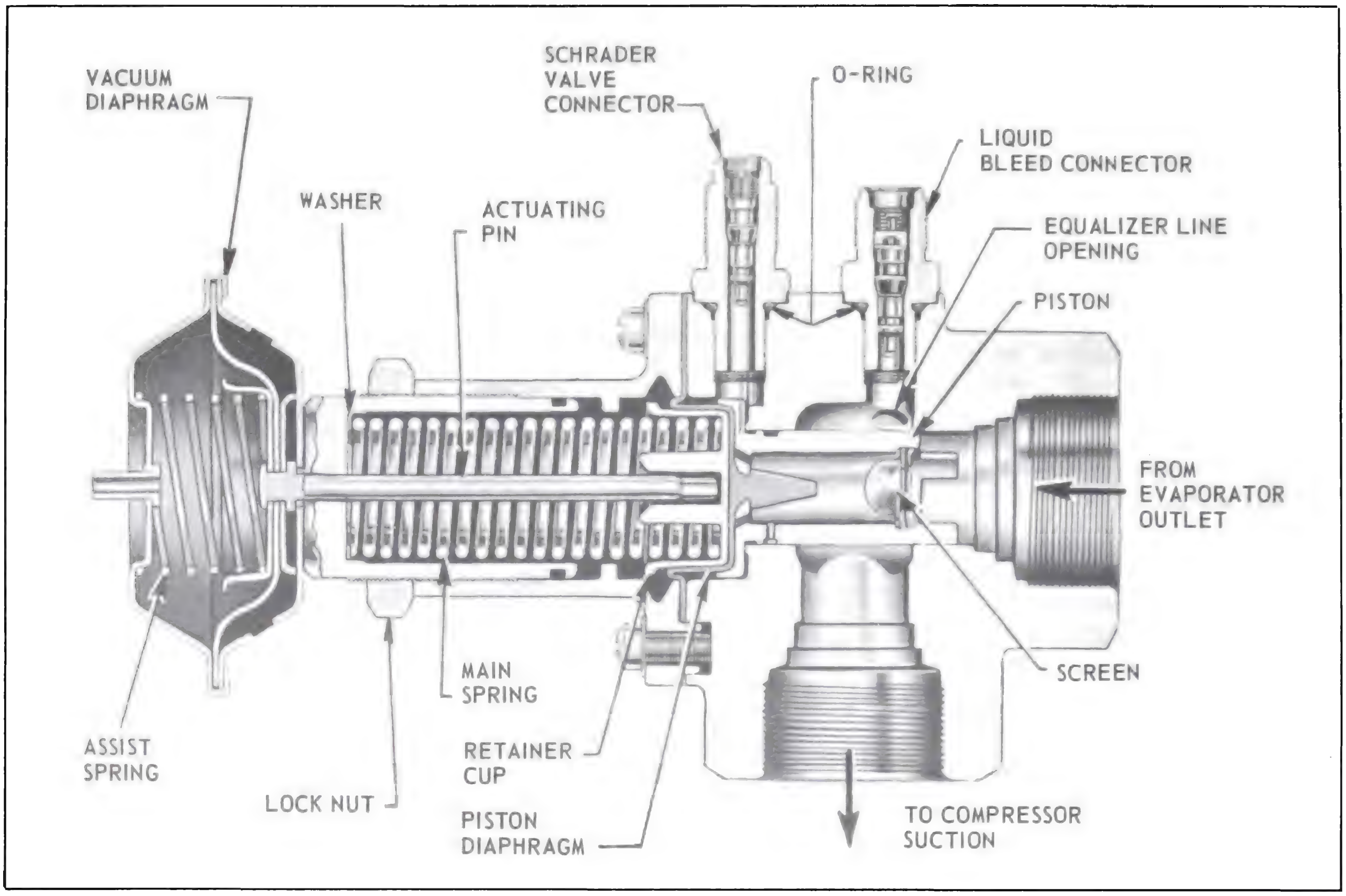


Figure 11-52—Suction Throttling Valve - 4400, 4600 and 4800 Series

present at its vacuum diaphragm and the spring tension is the only controlling factor. When at the maximum cool position, evaporating pressure is allowed to go to a minimum of 20 to 22 psi. If pressure is allowed to go any lower, icing of the evaporator core will occur.

(b) Minimum cooling setting of 4700 STV -- The minimum cooling setting of the 4700 STV is obtained when 6-1/2" (±1/2") of vacuum is applied to STV vacuum diaphragm. To move the piston in the STV, the evaporator pressure must overcome spring tension plus the force applied by the actuating pin to the piston diaphragm. This force on the piston's diaphragm maintains an evaporator pressure of approximately 50 psi minimum.

(c) Maximum cooling setting of the 4400, 4600 and 4800 STV. The maximum cooling setting of the 4400, 4600 and 4800 STV is obtained when 4-1/2 inches of vacuum is applied to the STV vacuum diaphragm. The internal spring in the diaphragm is compressed, thus the spring in the cover is the only controlling factor. When at the maximum cooling position, evaporator pressure is allowed to go to a minimum of 29-31 psi. If pressure is allowed to go lower, icing of the evaporator will occur.

(d) Minimum cooling setting of the 4400, 4600 and 4800 STV. The minimum cooling setting is obtained when vacuum is not applied to the vacuum diaphragm. The diaphragm spring tension is added to the tension of the spring in the cover. The evaporator pressure then must overcome both springs to move the piston. The evaporator pressure will be maintained at approximately 32 to 34 psi.

NOTE: At 60 mph it will not be unusual for the compressor inlet pressure to be from 10 to 15 psi, while the evaporator is controlled at 30 psi. Frost accumulates on the compressor inlet line after prolonged operation at these conditions. At minimum, or further reduced-load conditions, when the throttling demands on the STV are again increased, the compressor inlet pressure may drop to zero psi, or even 6"— 8" of vacuum. Compressor inlet temperatures at these reduced load conditions may approach minus 30° F. so that even frosting of the compressor rear head is possible.

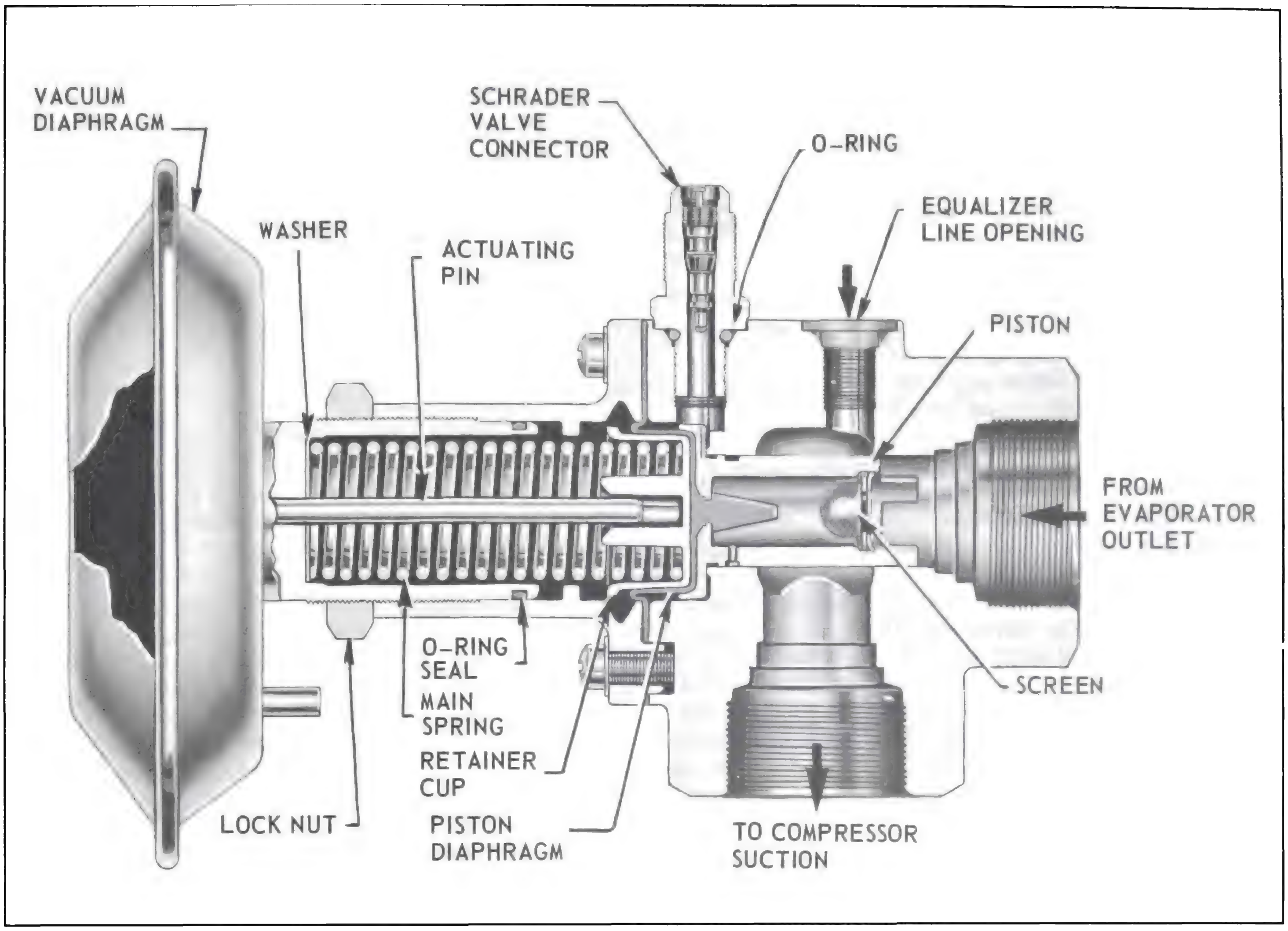


Figure 11-53—Suction Throttling Valve - 4700 Series

8. Vacuum Modulator - 4700. The vacuum modulator which controls the amount of vacuum to the 4700 suction throttle valve vacuum diaphragm, is mounted on the air conditioner control assembly on the center console. It is activated by the air conditioner temperature control lever and the FAN switch control lever.

Engine intake manifold vacuum is present at the vacuum modulator when the air conditioner control system is energized. The vacuum modulator controls the output vacuum to the suction throttling valve from 6-7 inches vacuum at minimum cooling, to 0 inches vacuum at maximum cooling. When air conditioner temperature control lever is moved from left to right, the vacuum is gradually decreased from 6-7 inches to a minimum of 2 1/2 inches when the lever is full on. When the air conditioning temperature lever is full on and the FAN switch con-

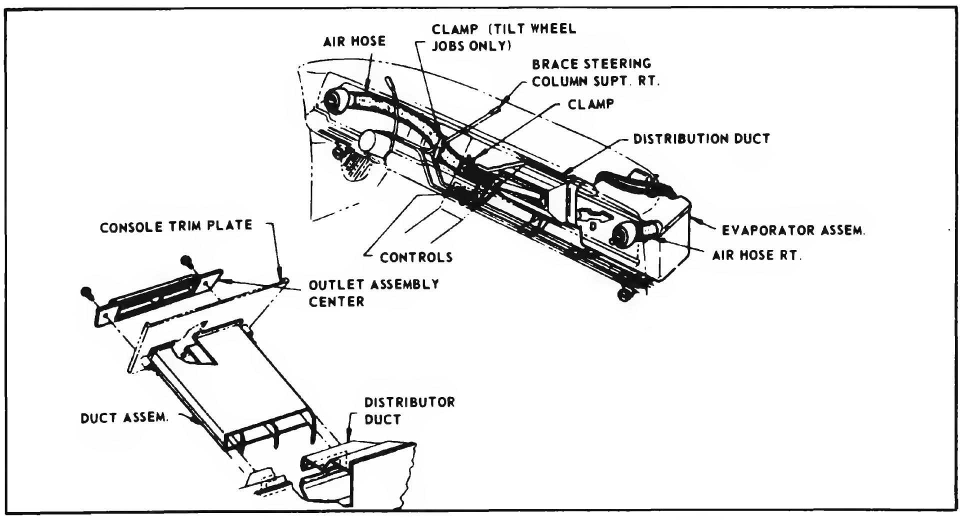


Figure 11-54—Air Conditioner Outlets - 4700 Series

trol is on HIGH position, the modulator shuts off the vacuum supply to the suction throttle valve vacuum diaphragm.

9. Air Outlets. The air conditioner air outlets are entirely separate from the heater outlets and are located as shown in Figures 11-54 and 11-55.

Air is introduced into the car through three outlets, two at each end of the instrument panel and one at the upper center of the instrument panel.

The outer outlets have a rotating ball to control air flow direction. See Figure 11-56.

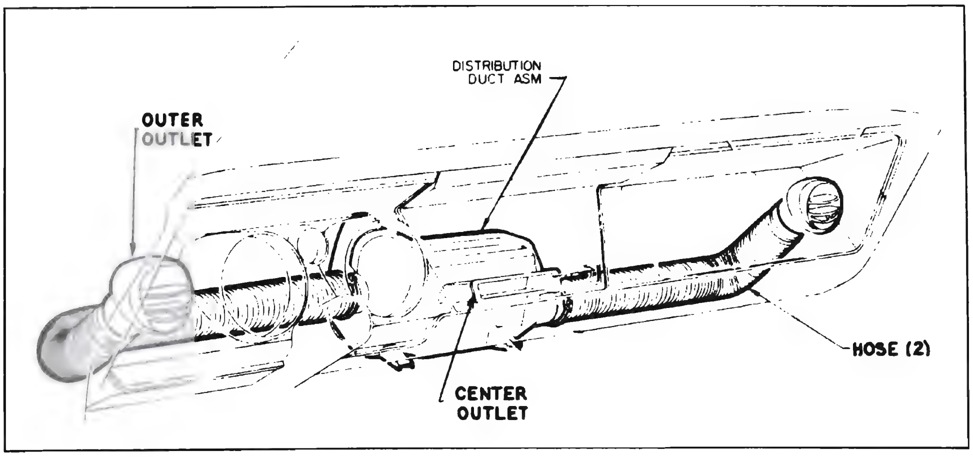


Figure 11-55—Air Conditioner Outlets - 4400, 4600 and 4800 Series

e. Air Conditioner Controls—4700 Series

NOTE: See paragraph 11-13 for 4400, 4600 and 4800 controls.

The air conditioner control levers for the 4700 are located directly under the heater control levers. See Figure 11-57. The vent control knobs are attached to the bottom of the instrument panel.

Control of the air conditioner is accomplished by use of three control levers; the air conditioner temperature control lever, the air control lever, and the FAN switch control. These controls function as follows:

1. Air Control Lever - Movement of the lever to VENT position performs three system changes. The outside and recirculated air door is fully opened, and the heater and evaporator air door is positioned to duct air flow to A/C outlets. In addition, the first half of the double contact circuit control switch closes and operates the blower motor at low-low speed. Further movement of the control lever to NORMAL position closes the second half of the circuit switch, thereby causing the compressor magnetic clutch to engage. At this point the air conditioner system begins to operate and the air flow is cooled. RECIRC position of the lever partially closes the outside and recirculated air door so that a portion of the air from inside the car recirculates thru the system.

2. Air Conditioner Temperature Control Lever - Movement of the lever from LOW to COOLER positions progressively decreases vacuum to the suction throttling valve by closing of the vacuum modulator situated on the control assembly.

Positioning of the control lever from LOW to COOLER positions progressively reduces the vacuum to the vacuum diaphragm of the STV. As vacuum is reduced, the temperature of the air flow is proportionately reduced.

3. FAN Switch Control - This lever regulates the blower speeds to low, medium, or high. In addition, when the lever is moved to HIGH position, the vacuum modulator is permitted to be completely shut off and all vacuum is removed from the vacuum diaphragm of the suction throttling valve, provided the air conditioner temperature lever is in COOLER position. When the FAN lever is in HIGH position, the air lever in RECIRC, and the air conditioner temperature lever in COOLER position — maximum cooling will result.

Figure 11-56—Air Conditioner Outer Outlet

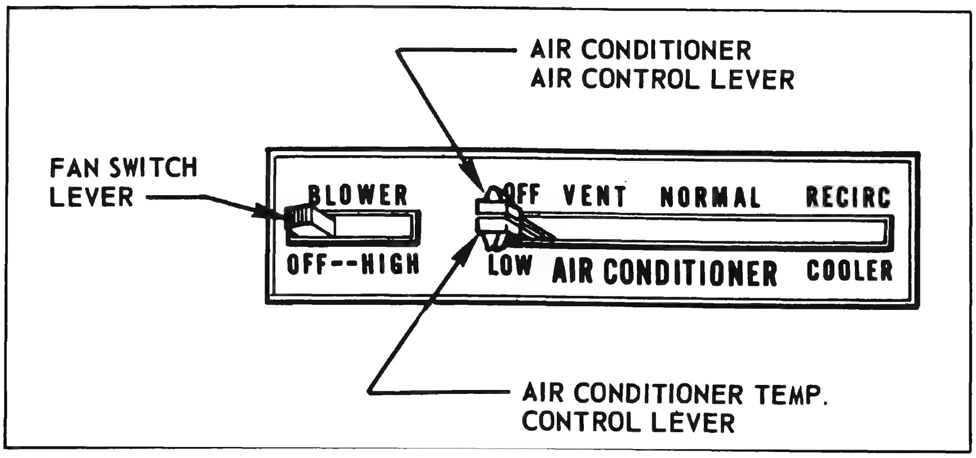


Figure 11-57—Air Conditioner Control Assembly - 4700 Series

f. Operation of Air Conditioner Refrigeration Circuit

Cool refrigerant gas is drawn into the compressor from the evaporator and pumped from the compressor to the condenser under high pressure. See Figures 11-58 and 11-59. This high pressure gas will also have a high temperature as a result of being subjected to compression. As this gas passes through the condenser, the high pressure, high temperature gas rejects its heat to the outside air as the air passes over the cooling surfaces of the condenser. The cooling of the gas causes it to condense into liquid refrigerant. The liquid refrigerant, still under high pressure, passes from the bottom of the condenser into the receiver-dehydrator. The receiver acts as a reservoir for the liquid.

The liquid refrigerant flows from receiver-dehydrator to the expansion valve. The valve meters the high pressure refrigerant flow into the evaporator. Since the pressure in the evaporator is relatively low, the refrigerant immediately begins to boil. As the refrigerant passes through the evaporator, it continues to boil, drawing heat from the surface of the evaporator core. The warm air passing over the evaporator rejects its heat to the cooler surfaces of the evaporator core. Any moisture in the air condenses on the cool surface of the core, resulting in cool dehumidified air entering inside the car. By the time the gas leaves the evaporator it has completely vaporized and is slightly super-heated. Super-heat is an increase in temperature of the gaseous refrigerant above the temperature at which the refrigerant vaporized.

The pressure in the evaporator is controlled by the suction throttle valve as described in subparagraph "a", item 7.

Refrigerant vapor passing through the evaporator, flows through the suction throttle valve and is returned to the compressor where the refrigeration cycle is repeated.

11-12 DESCRIPTION AND OPERATION OF AIR CONDITIONER COMPRESSOR

The compressor is mounted on the right front of the engine over the generator. The compressor is of basic double action piston design. Three horizontal double acting pistons make up a six cylinder compressor, and are mounted axially around the compressor shaft to operate in a front and rear cylinder assembly. These pistons operate in a 1-1/2 inch bore, have a 1-1/8 inch stroke and are actuated by a swash plate pressed on the compressor shaft. See Figures 11-60 and 11-61.

Reed type suction and discharge valves are mounted in a valve plate between the cylinder assembly and the head at each end of the compressor. The heads are connected with each other by gas-tight passage ways which direct refrigerant gas to a common output.

a. Suction Reed Valves and Discharge Valve Plates

A three-reed suction valve disc is assembled to both the front and rear cylinder heads. See Figure 11-62. These reeds open when the pistons are on the intake portion of their stroke to allow the low pressure vapor to flow into the cylinders.

When the pistons reverse and are on the compression portion of their stroke, the reed valves close against their seats to prevent the high pressure vapor being forced back into the low side of the system.

There are two discharge valve plate assemblies, each having three reeds and retainers positioned to direct the high pressure vapor from the cylinders into the outer annular cavities of the front and rear head castings. When the piston has completed its compression stroke and reverses to the suction stroke, the high pressure vapor in the discharge cavity causes the reeds to close, thus maintaining the differential of pressure between the high and low pressure areas.

b. Cylinder Heads

Each cylinder head contains suction and discharge cavities. In

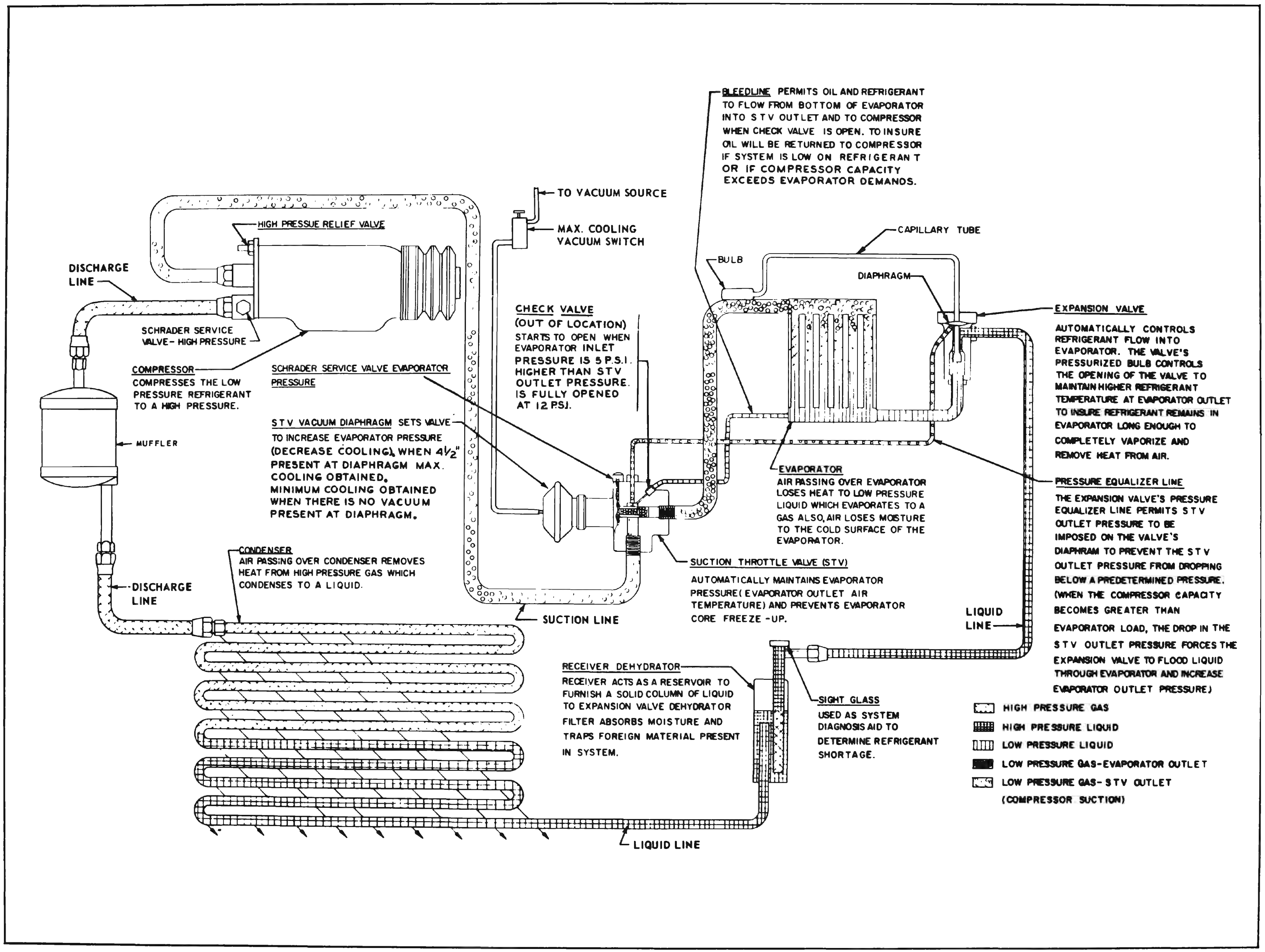


Figure 11-58—Air Conditioner Refrigerant Circuit - 4400, 4600 and 4800 Series

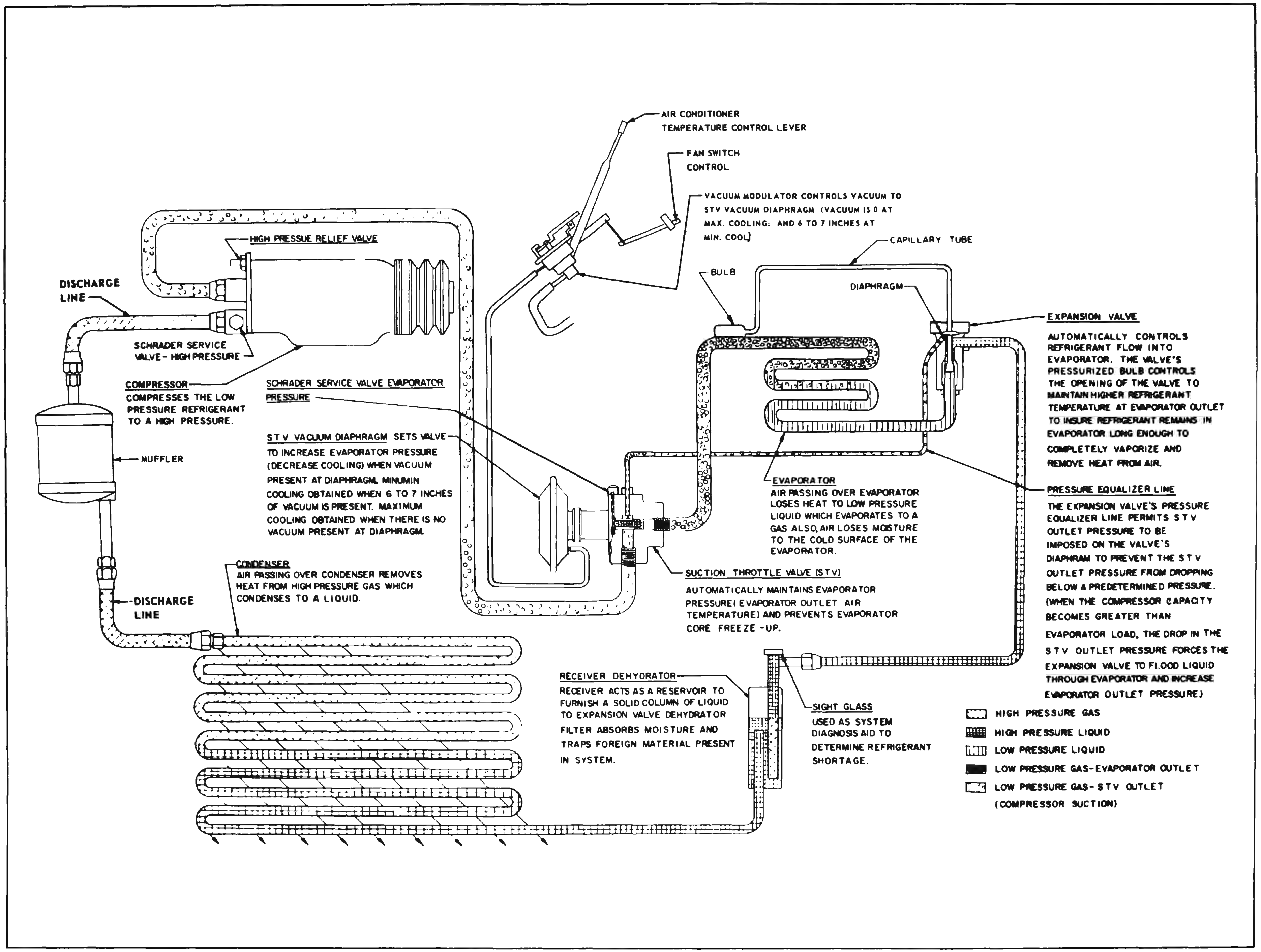


Figure 11-59—Air Conditioner Refrigerant Circuit - 4700 Series

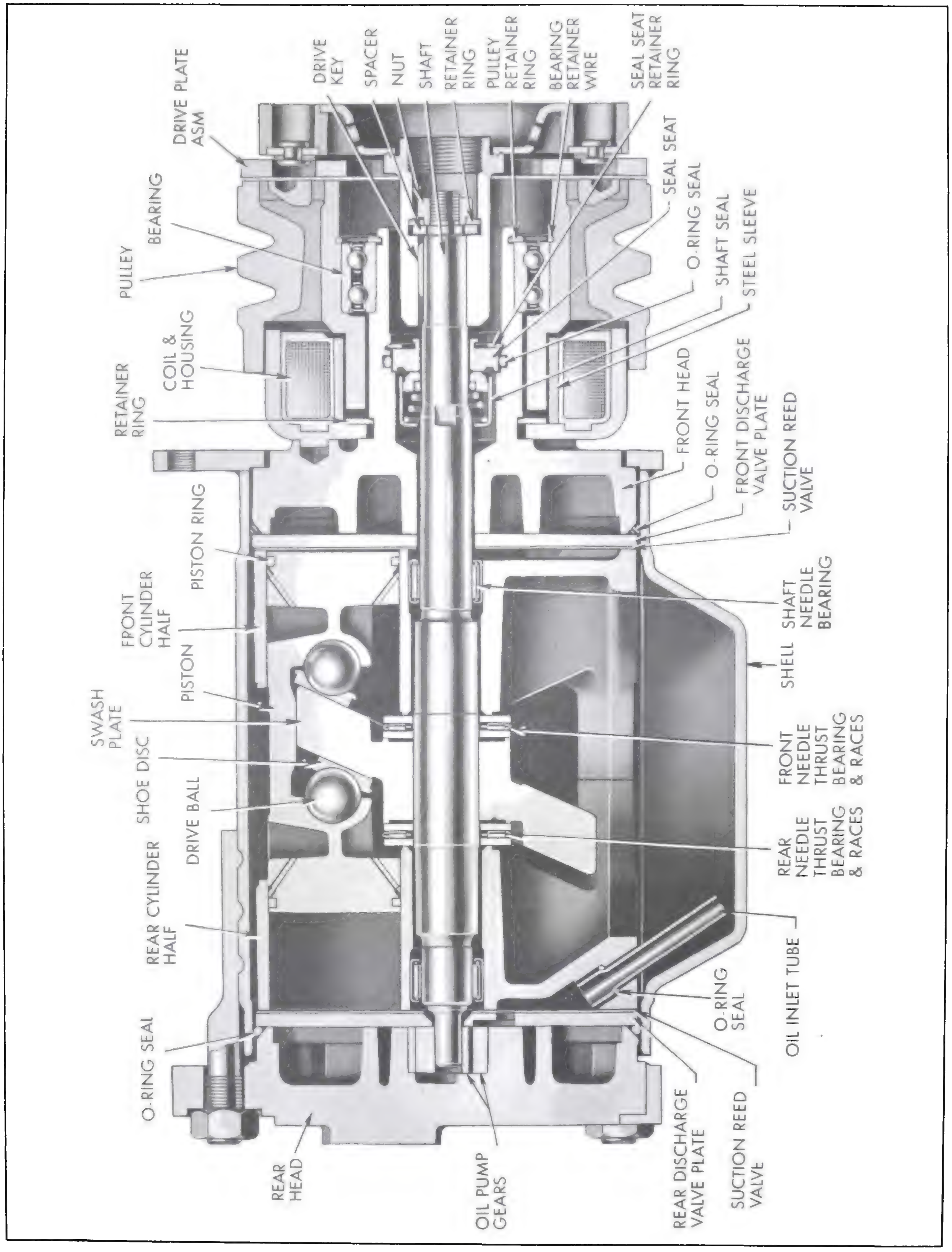


Figure 11-60—Sectional View of Compressor - 4600, 4700 and 4800 Series

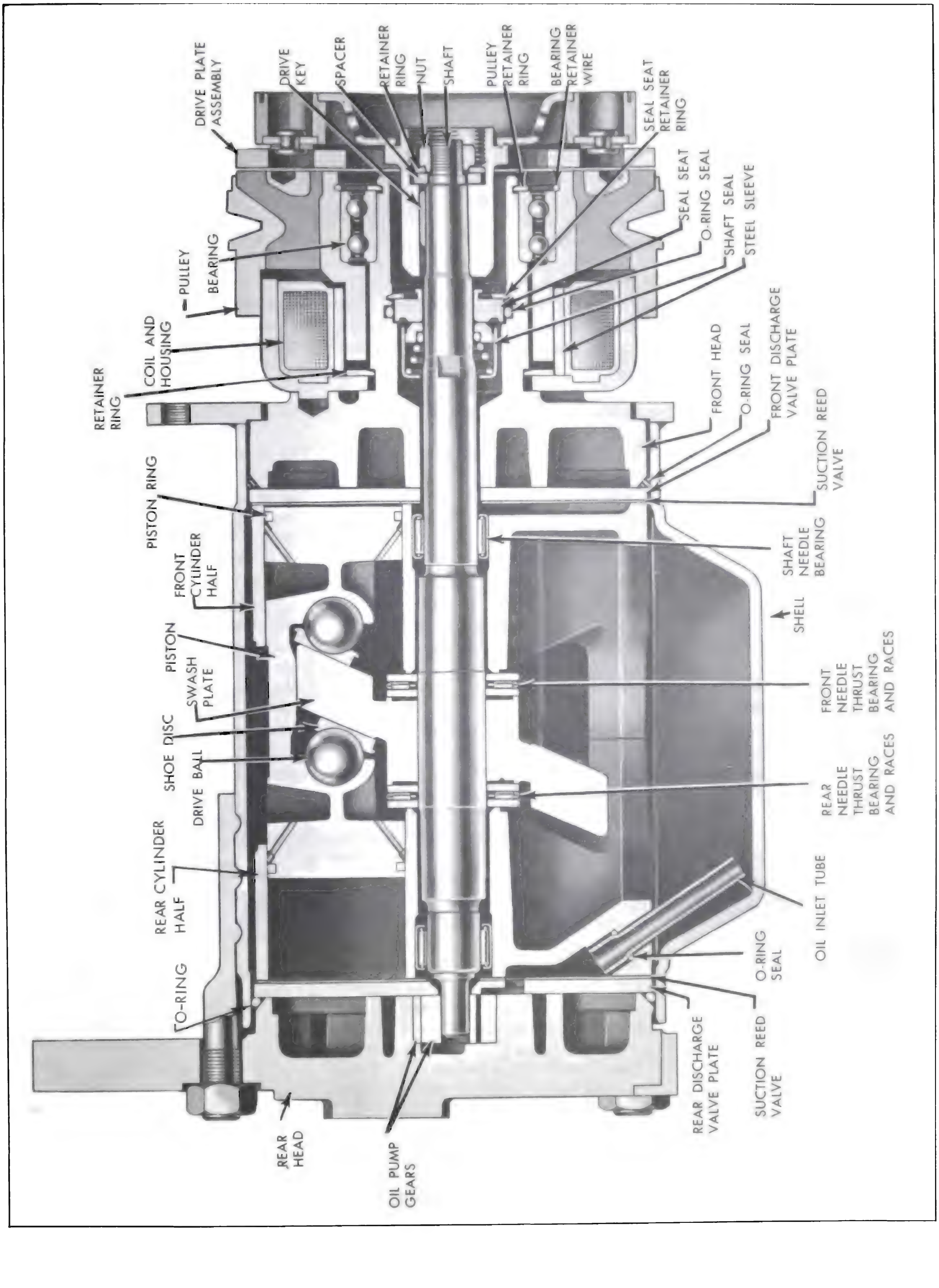


Figure 11-61—Sectional View of Compressor - 4400 Series

addition, the rear head contains an oil pump cavity in the center of the suction cavity to house the oil pump gears (which are driven by the compressor mainshaft). The suction cavity is in the center and indexes with the suction reeds. The discharge cavity is around the outside and indexes with the discharge reeds.

These cavities are sealed from each other with a teflon seal molded into the cylinder heads. The discharge cavity is sealed from the outside of the compressor by an "O" ring seal which rests in a chamfered relief in the cylinder head and compresses against the compressor body.

Both cylinder heads are connected with each other; the suction cavities by a flat suction pass cover, the discharge cavity by a discharge tube pressed into each head. (Service discharge tube assemblies are sealed with "O" rings and bushings.)

c. Oil Pump

An oil pump mounted at the rear of the compressor picks up oil from the bottom of the compressor and pumps it to the internal parts. The inner gear has a "D" shaped hole in the center which fits over a matching "D" flat

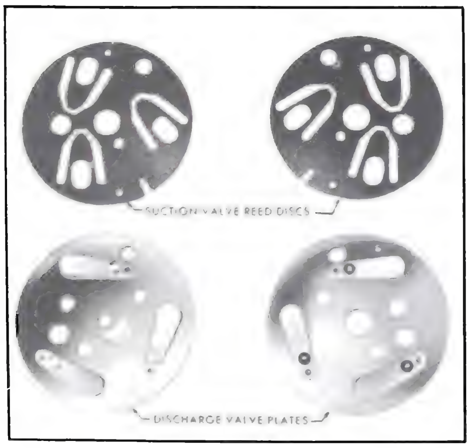


Figure 11-62—Suction Valve Reed Discs and Discharge Valve Plates

on the rear of the main shaft. The outer driven gear has internal gear teeth which mesh with the external teeth on the inner (drive) gear.

d. Main Shaft

The compressor main shaft is driven by the pulley when the magnetic clutch is energized. The shaft extends through the compressor front head, to the compressor rear head and drives the oil pump in the rear head. The shaft is supported by a needle roller bearing located in the front half of the cylinder and a similar needle roller bearing in the rear half of the cylinder.

A 3/16 inch diameter oil passage extends from the rear oil pump cavity to the shaft seal cavity. Four 5/64 inch diameter holes are drilled at 90 degrees to the main oil passage. These drilled passages direct oil, under pump pressure, to the shaft seal surfaces, thrust bearings, and shaft cylinder bearings. See Figure 11-63.

e. Thrust Bearings and Races

Two needle thrust bearings are seated around the shaft and are located near the center of the compressor. These bearings have rollers placed radially in their housing. Each bearing is "sandwitched" between two steel thrust races, and this combination of three pieces is placed between the shoulders of the swash plate and the shoulders of the cylinder hubs on the front and rear halves of the cylinder. See Figure 11-64.

The front end combination, consisting of a needle bearing with a selected thrust race on each side, provides the proper head clearance below the top of cylinder and the underside of the suction and discharge valve plates. See Figure 11-65.

The rear end combination, consisting of a needle bearing with a selected thrust race on each side, obtains a .005 to .0015 running clearance between the hub surfaces of the swash plate and the front and rear hubs of the cylinder.

f. Cylinder Block and Piston

The cylinder assembly consists of two halves, front and rear.

Alignment and register of the two halves are maintained by two locator (roll) pins. Cylinder block assemblies are only serviced in matched sets (front and rear halves).

The double end pistons are made of cast aluminum. Each piston has a notch cast in one end for identification purposes. This notched end of the piston is to be positioned toward the front end (pulley end) of the compressor.

Both ends of the pistons have a groove to receive a piston ring. Two oil return holes are drilled behind the ring groove and extend toward the center area of the piston to allow oil to drain to the compressor oil sump. The piston rings have an oil scraper groove at one edge to wipe any excess oil back into the oil sump (reservoir) through the oil return holes.

A spherical cavity is located in the inside center on each side of

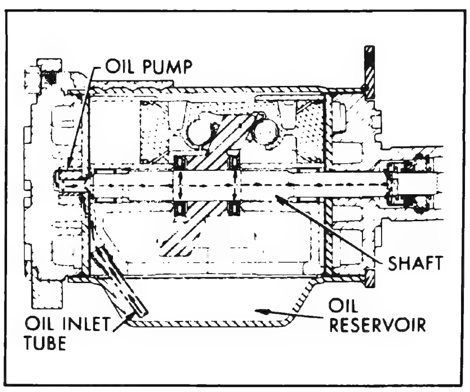


Figure 11-63—Oil Flow in Compressor

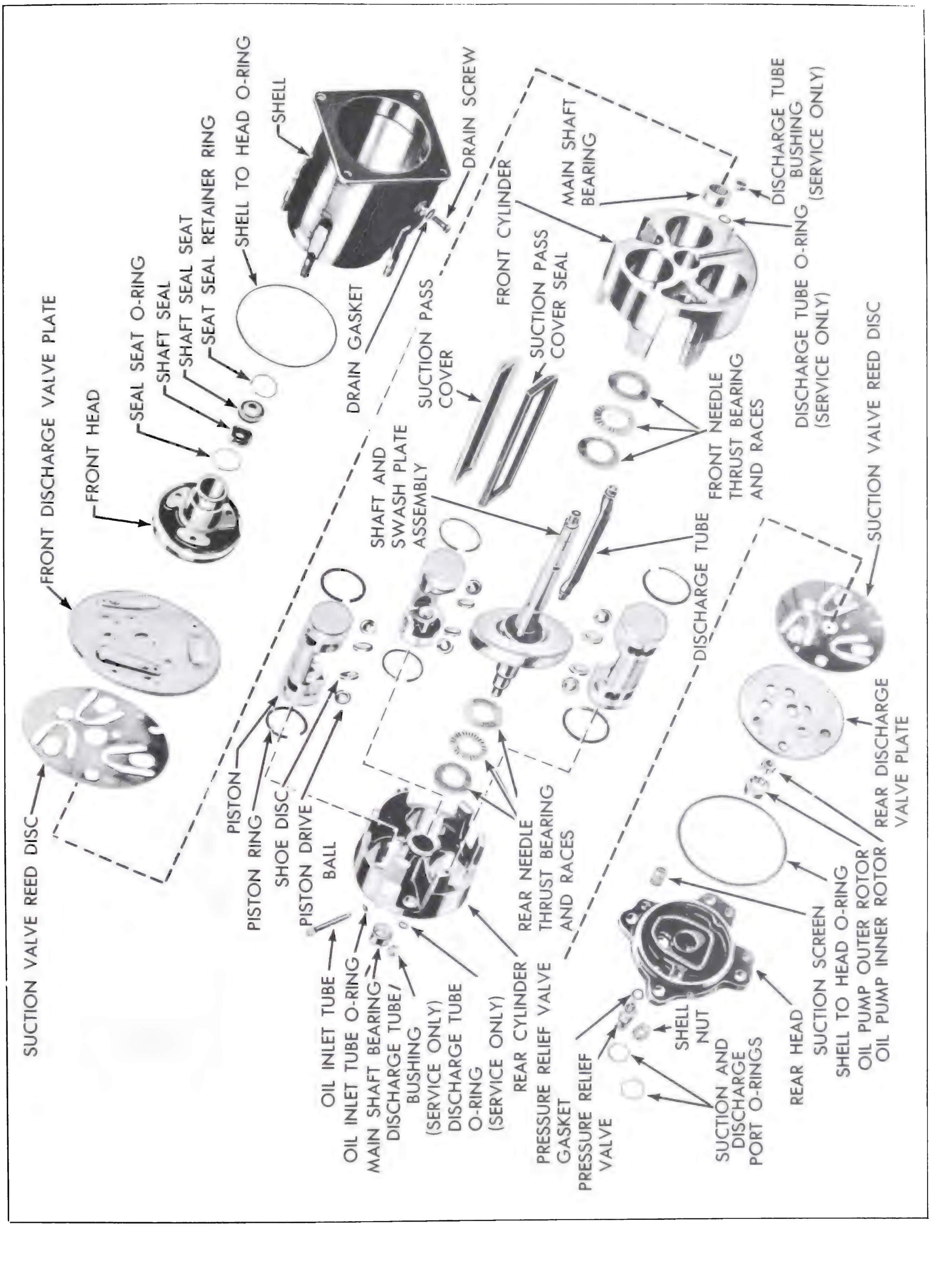


Figure 11-64—Exploded View of Compressor

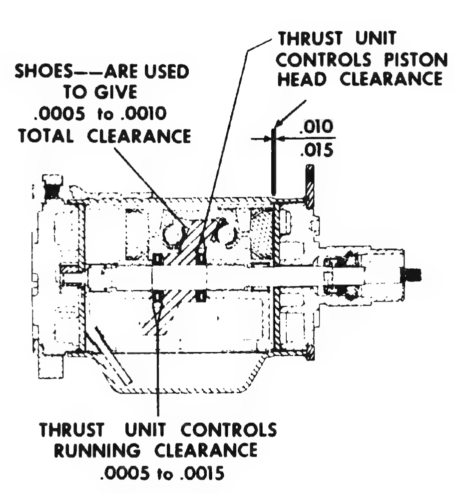


Figure 11-65—Compressor Internal Clearances

the pistons to receive the drive balls (see Figure 11-64).

g. Shoe Discs

Shoe discs are made of bronze and one side is a flat surface which contacts the surface of the swash plate. The opposite side has a coined concave surface into which is assembled the drive ball.

These shoes are provided in .005 inch increments and ten sizes are available for servicing these parts. Also, a basic zero shoe size is available for use during compressor rebuilding operations.

All service shoes will be marked with the shoe size, which will also correspond to the last three digits of the part number.

h. Swash Plate

An angular shaped member (swash plate) is located near the center of the compressor. The swash plate changes the rotating action of the shaft to provide a reciprocating driving force to each of the three pistons. This driving force is applied, through the shoes and balls, to the mid-point of each of the double end pistons. The swash plate has two angular faces ground smooth and parallel to permit smooth sliding of the shoe discs.

The plate is a press fit on to the drive shaft and is positioned by a Woodruff key. The swash plate and shaft are serviced only as an assembly.

i. Suction Pass Cover

Since the pistons are double-acting, low pressure vapor from the suction throttle valve must be supplied to both ends of the compressor and pistons.

The inlet (suction) port on the rear head of the compressor is connected by a hose to the outlet side of the suction throttle valve. A fine mesh suction screen is located in the low pressure inlet cavity of the rear head. Its purpose is to trap any material that could damage the compressor mechanism. See Figure 11-66.

A flat rectangular cavity is cast into the outer face of the front and rear cylinders. The edges of this cavity are machined into a "dove-tail" shape to retain a rectangular suction pass cover with a neuphrene seal around its edges. This cover and seal form a passage for the low pressure vapor to flow from the rear head of the compressor to the front head and thus supply suction refrigerant to the pistons and cylinders at the front of the compressor.

j. Production Type Discharge Tube

The double-acting pistons produce a high pressure vapor at both ends of the compressor. The outlet (discharge) port for the high pressure vapor is located in the rear head of the compressor. See Figure 11-66.

A discharge vapor tube is used to connect the front head discharge cavity to the rear head discharge cavity. This tube has cylindrical ends that are spun into a hole in the front and rear cylinder head casting to provide a vapor tight joint. The center of this tube has a flattened mid-section to provide clearance between the swash plate and tube.

When the pistons in the front end of the cylinder are on their compression stroke, the high pressure vapor is caused to flow into the discharge cavity in the front head, through the discharge cavity. This vapor combines with the high pressure vapor produced by the pistons in the rear cylinder head during their compression stroke and flows out the compressor discharge port.

k. Service Type Discharge Tube

The function and design of the service discharge tube are the

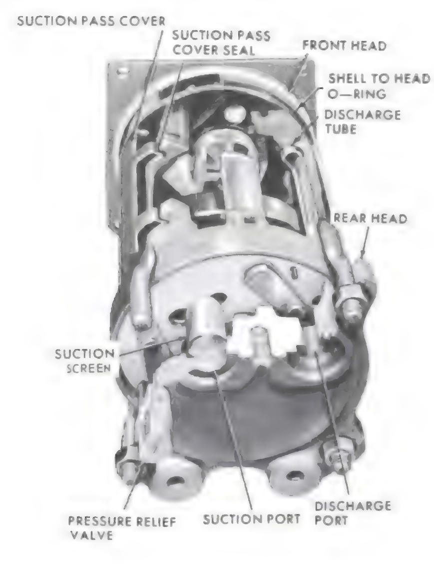


Figure 11-66—Compressor (Rear Cutaway View)

same as that for the production type tube with the exception of shouldered sleeves located in both ends of the service tube. See Figure 11-67. These shoulders provide a surface for the "O"-rings and compression bushings. Since the production discharge tube is vapor sealed to the front and rear cylinder heads by "spinning in" the ends of the tube, equipment to perform this "spin in" operation during service operation would not be economical. Therefore, if it should be necessary to separate the cylinder halves during a service operation, a service type discharge tube should be used when reassembling the mechanism.

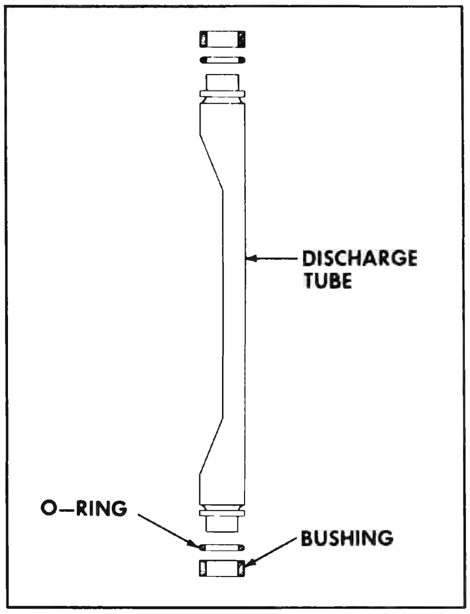


Figure 11-67—Service Type Discharge Tube

l. Pressure Relief Valve

The compressor is fitted with a high pressure relief valve. See Figure 11-66. If the discharge pressure exceeds approximately 440 psi, the relief valve opens automatically to relieve the pressure and closes again when the pressure decreases.

Opening of the relief valve will be accompanied by a loud popping noise, and perhaps the ejection of some oil with the refrigerant. Any condition that causes this valve to open should be corrected immediately.

m. Oil Drain Screw

An oil drain screw is located on the under side of the compressor shell. This screw is used just for draining and adding oil. It is not an oil test outlet as the oil level cannot be checked while the compressor is installed on the engine due to the design of the compressor. It is not necessary to check compressor oil unless a large amount of oil has been lost. This could happen only with a sudden breaking of a line or some other serious break in system. If there has been a major loss of oil, the compressor should be removed and drained and oil added as outlined under Checking Compressor Oil and Adding Oil, paragraph 11-15, subparagraph "k".

n. Shell

The shell of the compressor has a mounting flange on the front end and four threaded screws welded to the outside at the rear. An oil sump is formed into the bottom of the shell with a baffle plate over the sump on the inside of the shell.

The compressor serial number is located on a plate on top of the compressor. This number should be included in all Product Information Reports, claims or correspondence concerning the compressor. The compressor part number is also shown on the serial number plate.

o. Magnetic Clutch and Pulley Assembly

The pulley assembly contains an electrically controlled magnetic clutch, permitting the compressor to operate only when refrigerated air is desired.

When the compressor clutch is not engaged, the compressor shaft does not turn, although the pulley is still being turned by the compressor belts.

The clutch armature plate, which is the movable member of the clutch drive plate assembly, is attached to the assembly by means of flat springs. The hub of this assembly is pressed over the compressor shaft and is aligned with a square drive key located in the keyway of the compressor shaft. This clutch drive plate assembly is held in place with a nut. See Figures 11-68 and 11-69.

A two-row ball bearing is pressed into the hub of the pulley assembly and held in place by a bearing-to-pulley retainer wire. The pulley assembly and bearing is pressed over the front head of the compressor and held in place by a bearing-to-head retainer ring.

The coil and housing assembly has 3.85 ohms resistance at 80° F. (surrounding temperature) and should not demand more than 3.2 amperes at 12 volts D.C.

Three protrusions on the rear of the coil housing fit into alignment holes in the front head of the compressor. When the coil and housing assembly is aligned and engaged with the front head, it is secured in place by the coil and housing retainer ring. If removed, it is important that the coil and housing be reassembled in their original position so that the wiring harness connector may be plugged on the coil terminals.

When the air conditioner controls are set for cooling, current flowing through the coil creates a magnetic force which flows

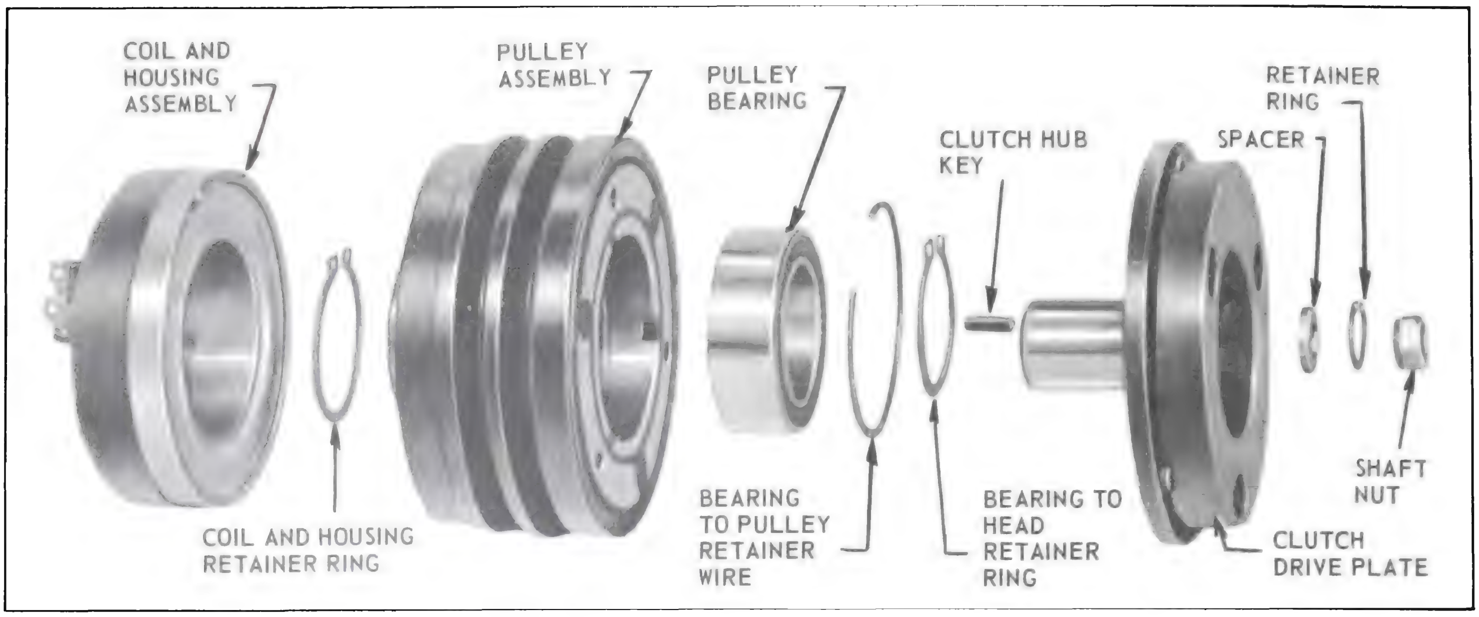


Figure 11-68—Compressor Magnetic Clutch Assembly - 4600, 4700 and 4800 Series

through the pulley to draw the armature plate rearward toward the pulley. As the armature plate moves toward the pulley, it contacts the pulley face.

The design of the clutch and coil is such that magnetic force locks the armature plate and pulley together as one unit. Since the armature plate hub is pressed on, and keyed to the compressor shaft, the shaft will then turn with the pulley.

When the air conditioner controls are turned off, the electric circuit to the compressor clutch is open and the magnetic pull on the clutch no longer exists.

The springs of the clutch drive plate assembly will then pull the armature plate away from the

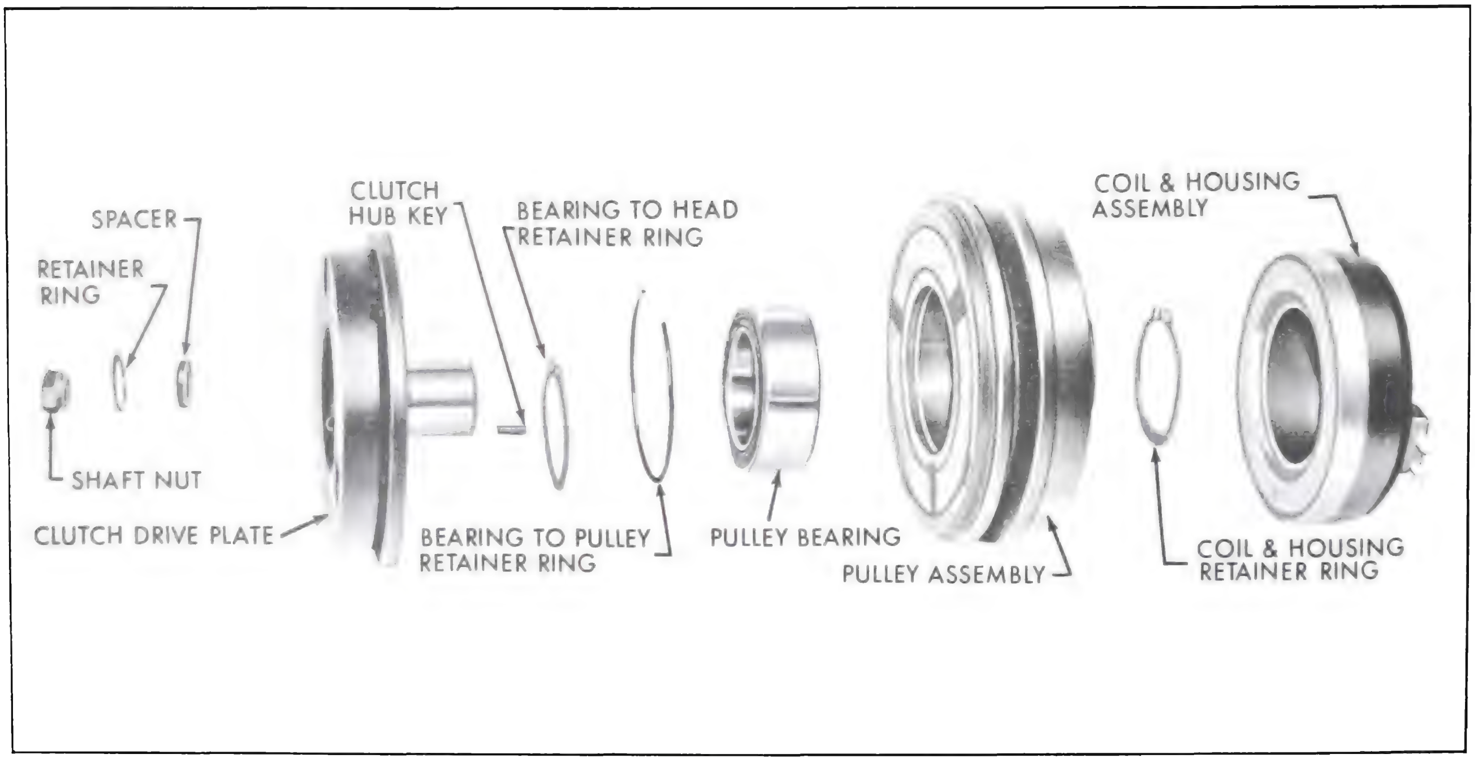


Figure 11-69—Compressor Magnetic Clutch Assembly - 4400 Series

pulley, and the plate loses contact with the pulley. With the clutch released, the pulley rotates freely on its bearing. In this condition, the compressor shaft does not rotate.

It may be noted that if the air conditioning system was in use when the engine was turned off, the armature plate may remain in contact with the pulley assembly, due to residual magnetism. This will cause no trouble, as the armature plate and pulley will separate as soon as the engine is started.

p. Compressor Shaft Seal

A replaceable shaft seal is used at the front of the compressor to seal the air conditioning system from atmosphere when the compressor is operating or at rest, regardless of pressures in the compressor.

Components of the seal located in the neck of the front head of the compressor are the seal seat retaining ring, the seal seat "O"-ring, the spring-loaded shaft seal and the cast iron shaft seal seat. The seal indexes with two flats machined on the compressor shaft and turns with the compressor shaft.

A spring in the shaft seal holds the seal against the seal seat which is held stationary in the neck of the compressor front head by the seal seat retainer ring.

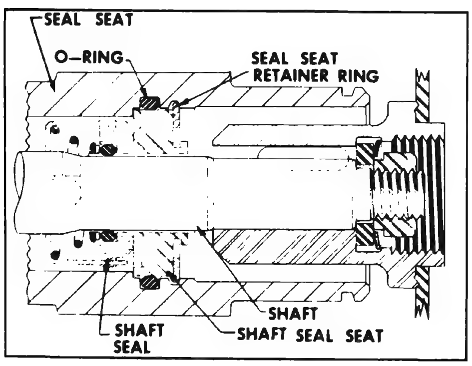


Figure 11-70—Shaft Seal Assembly

Because of the constant pressures inside the compressor, this surface must be protected against damage, such as scratches and nicks (even finger markings may cause surface damage) to prevent oil and/or refrigerant leaks past this seal.

Shaft seal service parts are supplied in a complete kit containing all necessary replacement parts.

11-13 HEATER-AIR CONDITIONER CONTROLS AND AIR DISTRIBUTION SYSTEM—4400-4600 AND 4800 SERIES

a. Heater-Air Conditioner Controls—4400, 4600 and 4800 Series

The controls for the 4400, 4600 and 4800 air conditioner heater consist of a four position control and four slide levers. See Figure 11-71.

To operate the system, it is necessary to select one of the four positions on the Climate Control: HEAT, VENT, AIR COND NORMAL or AIR COND RECIR. The selected mode of operation is then controlled by first moving the AIR lever, then moving one or all of the other three slide levers: TEMP, DEFR and REAR.

The operation of each system starts by moving the AIR lever and is stopped when the lever is returned to the off position.

The Climate control is a four position rotary control vacuum selector valve and a combination blower and compressor clutch control switch. The vacuum selector valve controls vacuum supply to two vacuum diaphragms located on the heater case and blower and air inlet assembly.

The electrical switch is operated

Figure 11-71—Air Conditioner Heater Controls - 4400, 4600 and 4800 Series

by the rotation of the selector valve through the four positions. The clutch and blower switch contacts are held open in the HEAT and VENT positions and are closed in both air conditioner positions to turn compressor on and set blower at low-low speed. See Figure 11-72.

The settings of the CLIMATE control are used as follows:

HEAT - This position gives low level air discharge for cold weather driving.

VENT- This setting gives upper level ventilation or warming as selected by operation of controls. The compressor does not operate at this position is primarily to be used in 30 to 50 degree outside air temperature when the upper level of car requires ventilation due to the high sun, and cooling is not desired.

AIR COND NORMAL - This position is for comfort under all weather conditions above 50 degree outside temperatures.

AIR COND RECIR - This setting is used when maximum refrigeration is desired.

The AIR lever control wire is attached to a circuit control assembly located on the heater case. See Figures 11-73 and 11-79. Included in the circuit control assembly is an electrical circuit control switch, blower

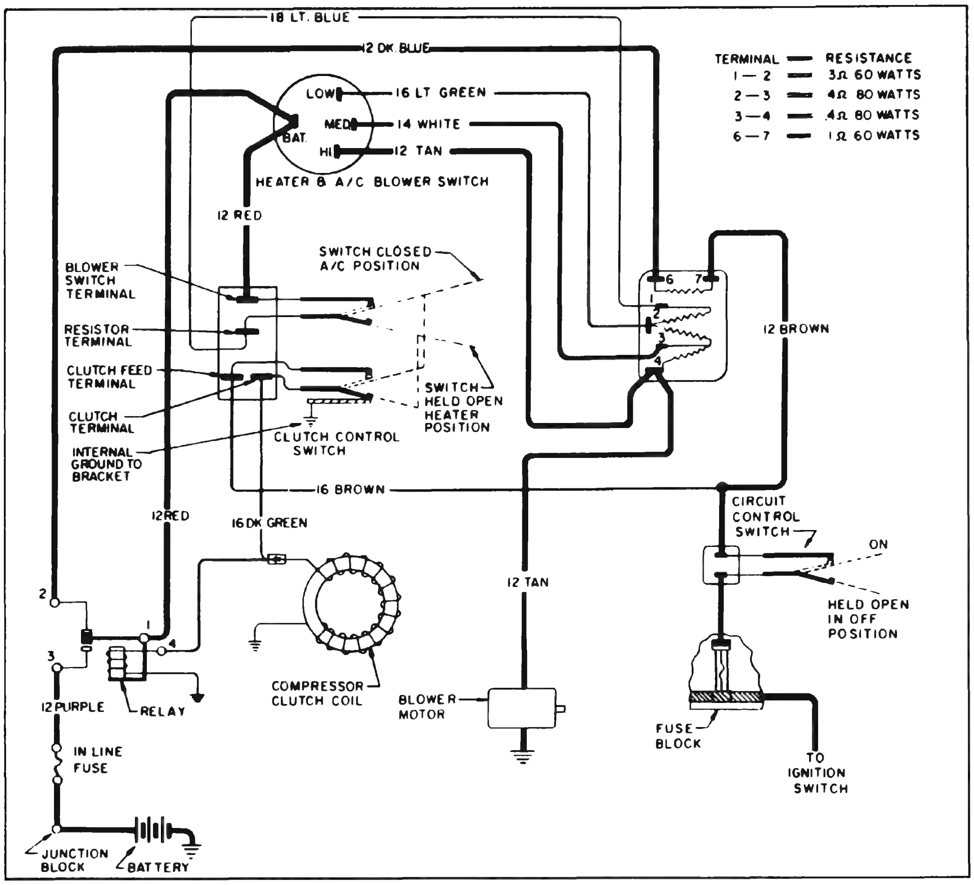


Figure 11-72—Heater-Air Conditioner Schematic - 4400, 4600 and 4800 Series

switch and the main vacuum switch. The Air lever wire operates the blower switch through five positions. For air conditioner operation the five positions are off, low-low, low, medium and high. For HEAT and VENT operations, the positions become off, ram air (blower off and car moving), low-low, low and medium.

When the AIR lever is at the off position the circuit control switch opens the air conditioner - heater electrical circuit, and the main vacuum switch shuts off the vacuum supply to the Climate Control and to the vacuum diaphragm located on the blower and air inlet assembly and heater assembly. When the Air lever is moved from the off position, besides operating the blower switch, the circuit switch is closed and the vacuum switch is opened.

The TEMP lever wire attaches to the temperature door. See Figure 11-73. Located at the temperature door is the max. cooling vacuum switch which controls the vacuum to the suction throttle valve vacuum diaphragm. Also, a second wire connects from the temperature door to the manual water valve. First movement of the TEMP lever from off, opens the water valve to allow water flow through the heater core. It also positions the temperature door to allow some air to pass through heater core, and closes the vacuum switch to set the suction throttle valve at its maximum cooling position. Further movement of the lever only positions the temperature door to allow more air to pass through the heater core.

The DEFR lever wire connects to the defroster door in the heater. Movement of this lever from off, directs air through the center outlet to the windshield. The REAR lever opens and closes the door in the rear floor duct adapter to allow air to be directed to the rear floor of car.

b. Air Distribution Doors and Vacuum Diaphragms

The 4400, 4600 and 4800 Air Conditioner-Heater system has five air distribution doors.

1. An outside recirculated air door is located on blower and air inlet assembly. See Figure 11-73 and 11-74. This air door is operated by a dual stage (#3 and #4) vacuum diaphragm.

2. A heater-air conditioner air door is located in the heater assembly and is operated by the #1 vacuum diaphragm. See Figure 11-74.

3. A temperature door, located in the heater assembly is operated by the TEMP lever control wire.

4. A defroster door is located in the heater assembly and is operated by the DEFR lever control wire.

5. A rear heat door is located in the rear floor duct adapter assembly and is controlled by the REAR lever control wire.

The outside-recirculated air door is normally held closed by a spring. When vacuum is applied to the #4 section of the dual stage vacuum diaphragm, it is positioned at the recirculated or one-fourth open position. When vacuum is applied to both the #3 and #4 sections of the dual diaphragm, the air door is pulled to the full open or outside air position. See Figure 11-75.

The heater-air conditioner air door is normally held in the air conditioner (open) position by a spring attached to its operating lever. See Figure 11-74. When

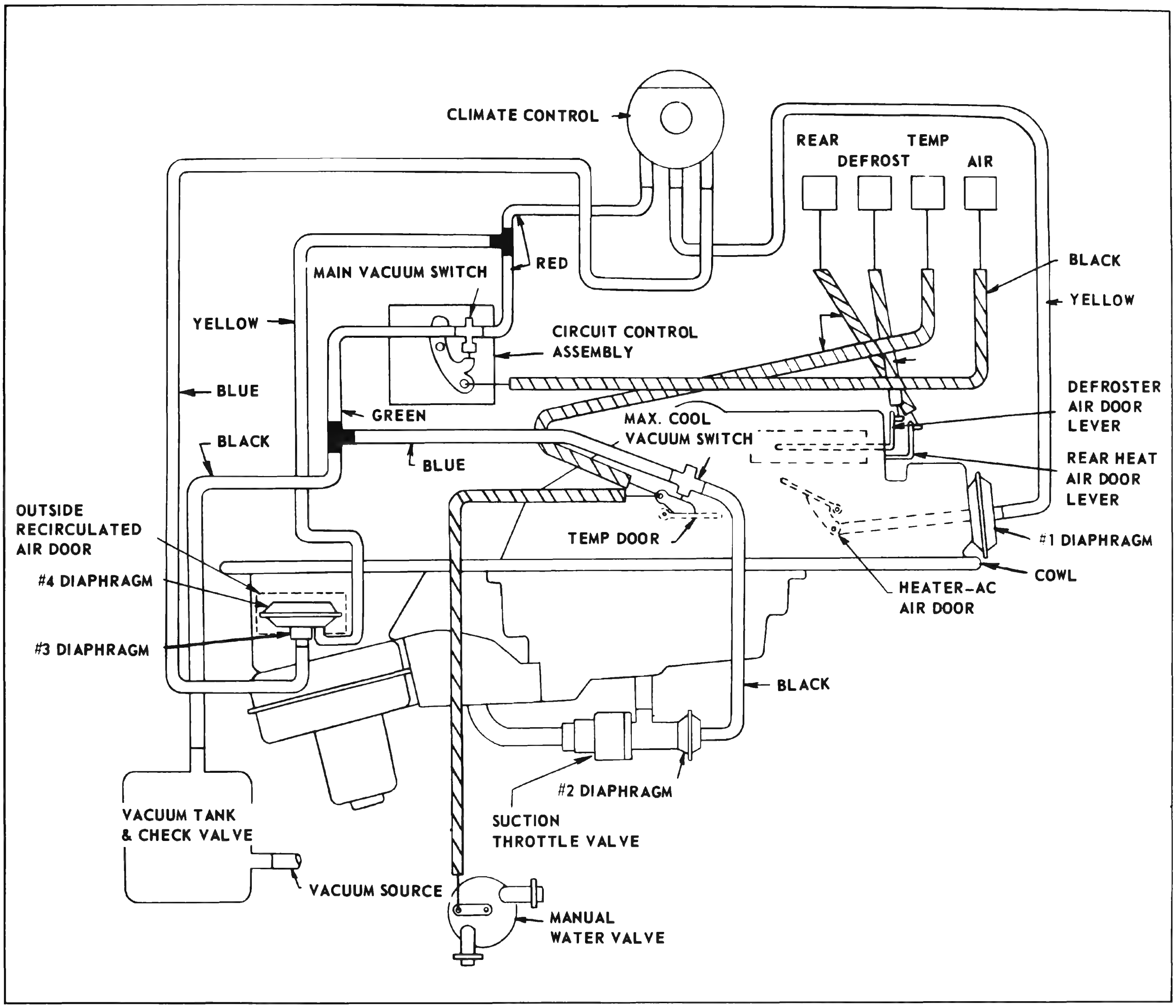


Figure 11-73—Vacuum Circuit and Control Wire Layout - 4400, 4600 and 4800 Series

the door is in this position, all air entering the system is directed through the air conditioner outlets. When vacuum is applied to the #1 vacuum diaphragm, the air door is pulled go the heater position, and all air entering the system is directed to the heater outlets.

When vacuum is exhausted from the diaphragm, the air doors return to their closed position.

c. Vacuum Switches

Two vacuum switches are used. See Figure 11-73. The main vacuum switch, which is operated by the Air lever and located on the circuit control assembly, is open (allows vacuum to pass through) when its plunger is fully released. The max. cooling vacuum switch, which is operated by the TEMP lever wire, is open when its plunger is fully depressed. The two vacuum switches must not be interchanged. When the vacuum switches are off or closed, they allow the vacuum in the diaphragm to be exhausted or vented through them so that the outside-recirculated air door will return to the off position.

d. Operation

To insure proper vacuum control operation, a vacuum supply tank and check valve assembly is used with the vacuum system. The

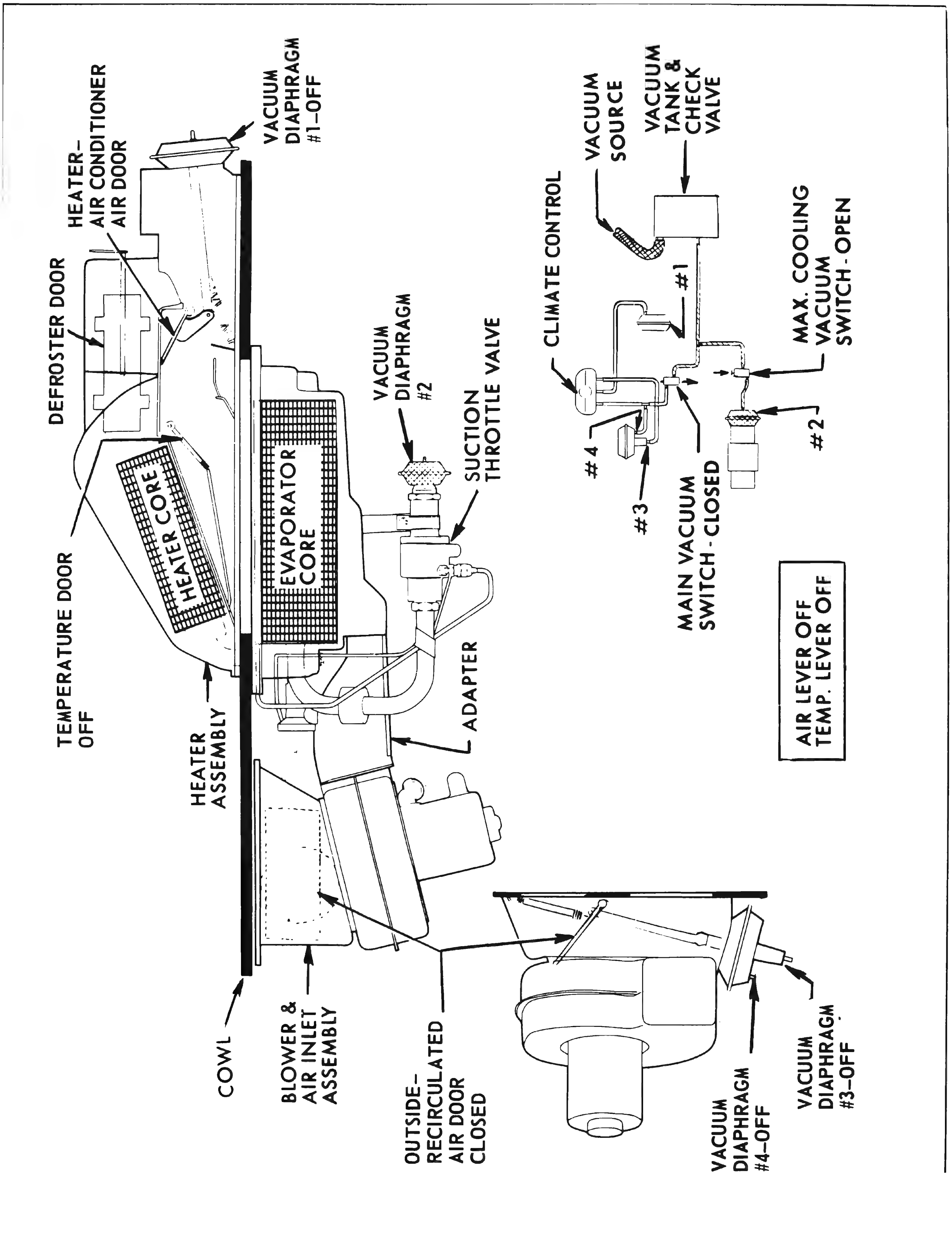


Figure 11-74—Air Conditioner and Heater Off - 4400, 4600 and 4800 Series

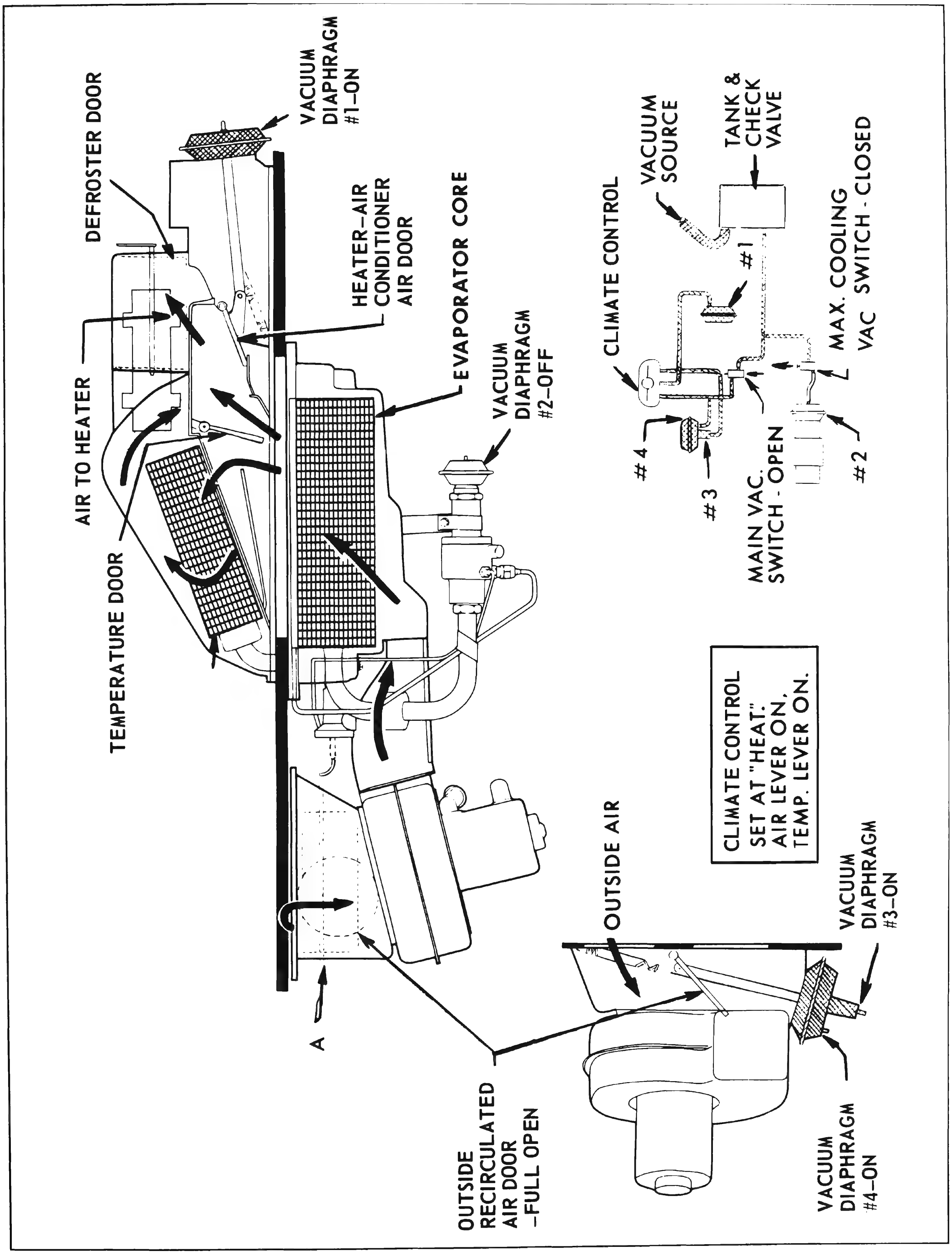


Figure 11-75—Air Conditioner Off, Heater On - 4400, 4600 and 4800 Series

check valve closes when intake manifold vacuum drops below a predetermined amount so that vacuum will remain in the system and operation of the air doors will not be affected.

The position of the air doors in the housing, the setting of the climate control, and the position of the vacuum switch with heater or air conditioner on is described as follows:

1. Air Conditioner and Heater Off - When the air lever is in the off position, both the air conditioner and heater are off. The outside-recirculated air door is held closed by its spring and the blower will not be operating. The main vacuum switch is closed. See Figure 11-74. The maximum cooling vacuum switch is open if the TEMP lever is also in the off position. This allows vacuum to be present at the suction throttle valves vacuum diaphragm, even though the air conditioner is not operating.

2. Air Conditioner Off, Hear On - When climate control is set at HEAT, the AIR and TEMP levers are moved forward from the off position for heater operation. The main vacuum switch is opened which allows vacuum to be present at the #4 vacuum diaphragm and climate control. The climate control allows vacuum at the #1 and #3 vacuum diaphgrams. Thus, the outside-recirculated air door is full open and the heater-air conditioner air door is positioned to direct air through the heater outlets. See Figure 11-75. The first movement of the TEMP lever wire opens the manual water valve to allow water to flow through heater core, positions the temperature door to direct some air through the heater core, and closes the maximum cooling switch (which has no effect on operation of heater) Full movement of the TEMP lever provides maximum heat by positioning the temperature door for all air to pass through the heater core.

3. Ventilation through Air Conditioner Outlets - To use the air conditioner outlets for outside air ventilation without cooling, set Climate Control at VENT and push AIR lever on. If heat is desired through air conditioner outlets, push TEMP lever on.

The air lever opens the main vacuum switch so that vacuum is present at the #4 vacuum diaphragm and Climate control. The Climate control allows vacuum to be present at the #3 vacuum diaphrgam. The outside air-recirculated air door is positioned full open allowing 100% outside air for ventilation. The #1 vacuum diaphragm does not have vacuum applied to it so the heater-air conditioner air door directs air to air conditioner outlets. See Figure 11-76.

4. Air Conditioner Normal, Heater Off or On - The climate control is set at AIR COND NORMAL and the AIR lever is pushed on. The outside-recirculated air door is full open as vacuum is present at #3 and #4 vacuum diaphragm. See Figure 11-77. The compressor clutch is engaged and the blower is set on low-low blower speed when the AIR lever is in the first detent from off. Further movement of the AIR lever increases blower speed to low, medium and high. The suction throttle valve is set at maximum cooling as vacuum is present at its vacuum diaphragm.

If warm-dry air is desired out of air conditioner outlets, leave climate control at AIR COND NORMAL and push TEMP lever on. This opens manual water valve, closes max. cooling vacuum switch, and positions temperature door to direct some air as it leaves evaporator to go through heater core. The further forward TEMP lever is positioned, the more air routed through the heater core and the warmer the air leaving air conditioner outlets. When TEMP lever is full on, some air will still by-pass heater core through the by-pass at left side of evaporator. This is allowed so that the air outlet temperature, when using air conditioner with heat, will not be as hot as when using just heater. In extreme cold weather, to obtain sufficient heating, the heater then should be used. This prevents needlessly running the air conditioner compressor.

5. Air Conditioner Maximum, Heat Off - The Climate Control is set at AIR COND RECIR, Air lever full on and the TEMP lever off. The outside-recirculated air door is set at the one-fourth open position by having vacuum applied only to the #4 section of the dual stage vacuum diaphragm. See Figure 11-77. This allows 1/4 outside air and 3/4 recirculated air to mix and be directed to the evaporator. With TEMP lever off, the suction throttle valve is set at maximum cooling and no air is directed through the heater core.

e. Air Distribution Chart—4400-4600-4800 Series

Listed in the following chart are the positions of the Climate Control, TEMP Lever, and AIR Lever, Diaphragm in Operation, Vacuum Switch that is Open and the Air Distribution.

f. Trouble Diagnosis—4400-4600-4800 Series

If the air conditioner-heater air distribution system does not function properly, first check the vacuum hose connections and control wire adjustments. See Figure 11-78. If this does not correct, check for vacuum at vacuum diaphragms, for proper operation of vacuum switches and climate control. See Figures 11-74 through 11-77. Refer to following chart for other possible causes.

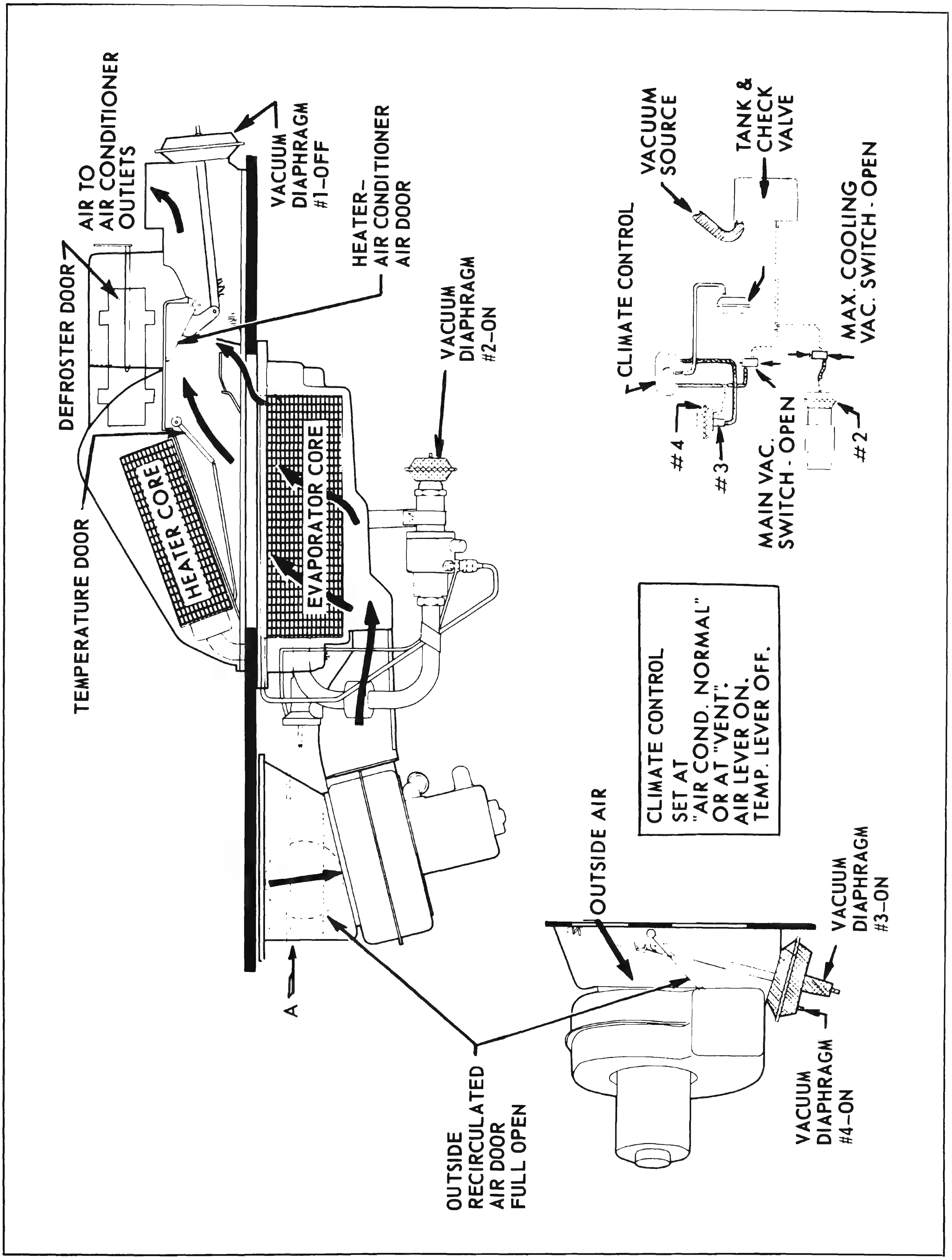


Figure 11-76—Air Conditioner Normal or Ventilation thru A/C Outlets, Heater Off - 4400, 4600 and 4800 Series

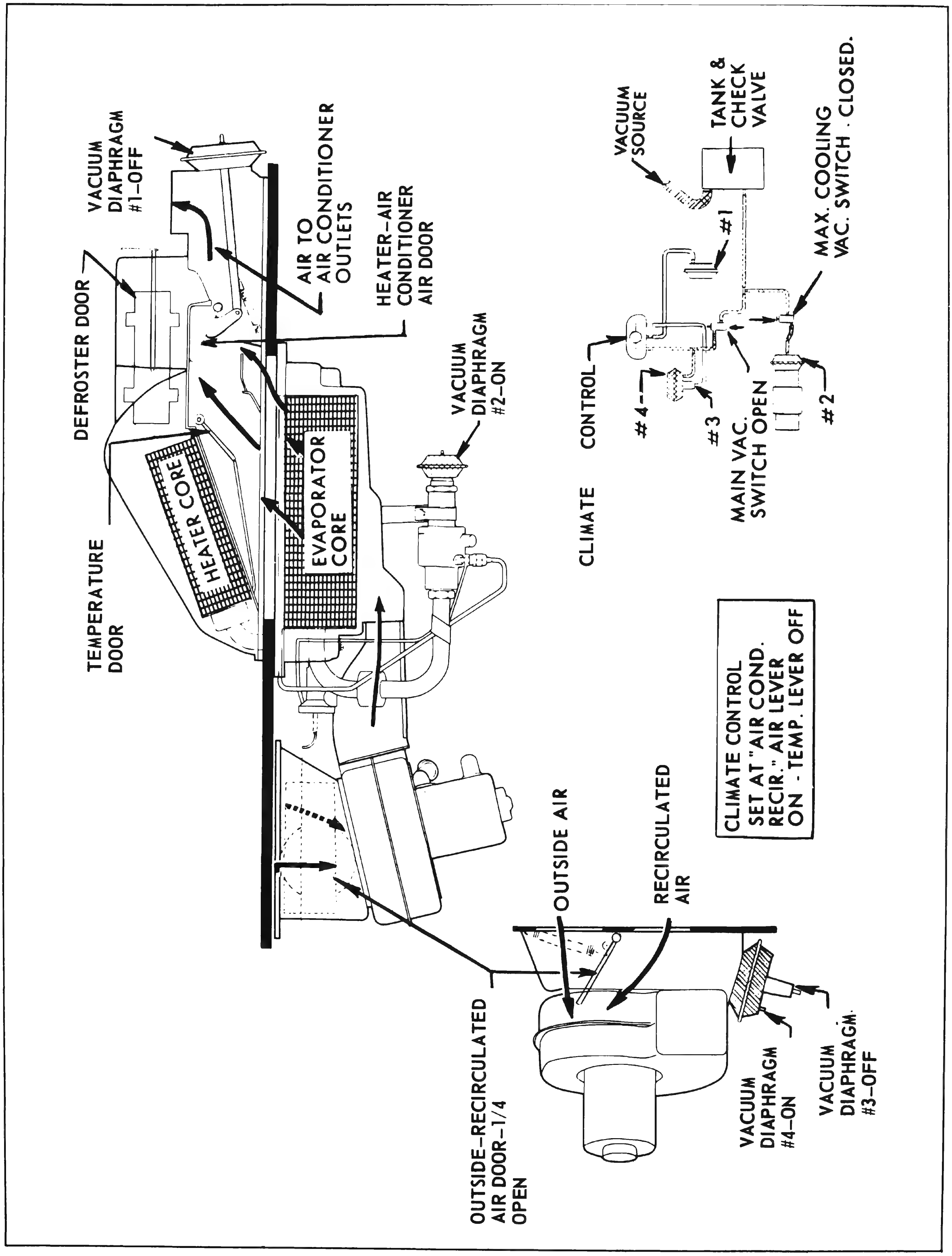


Figure 11-77—Air Conditioner Maximum, Heater Off - 4400, 4600 and 4800 Series

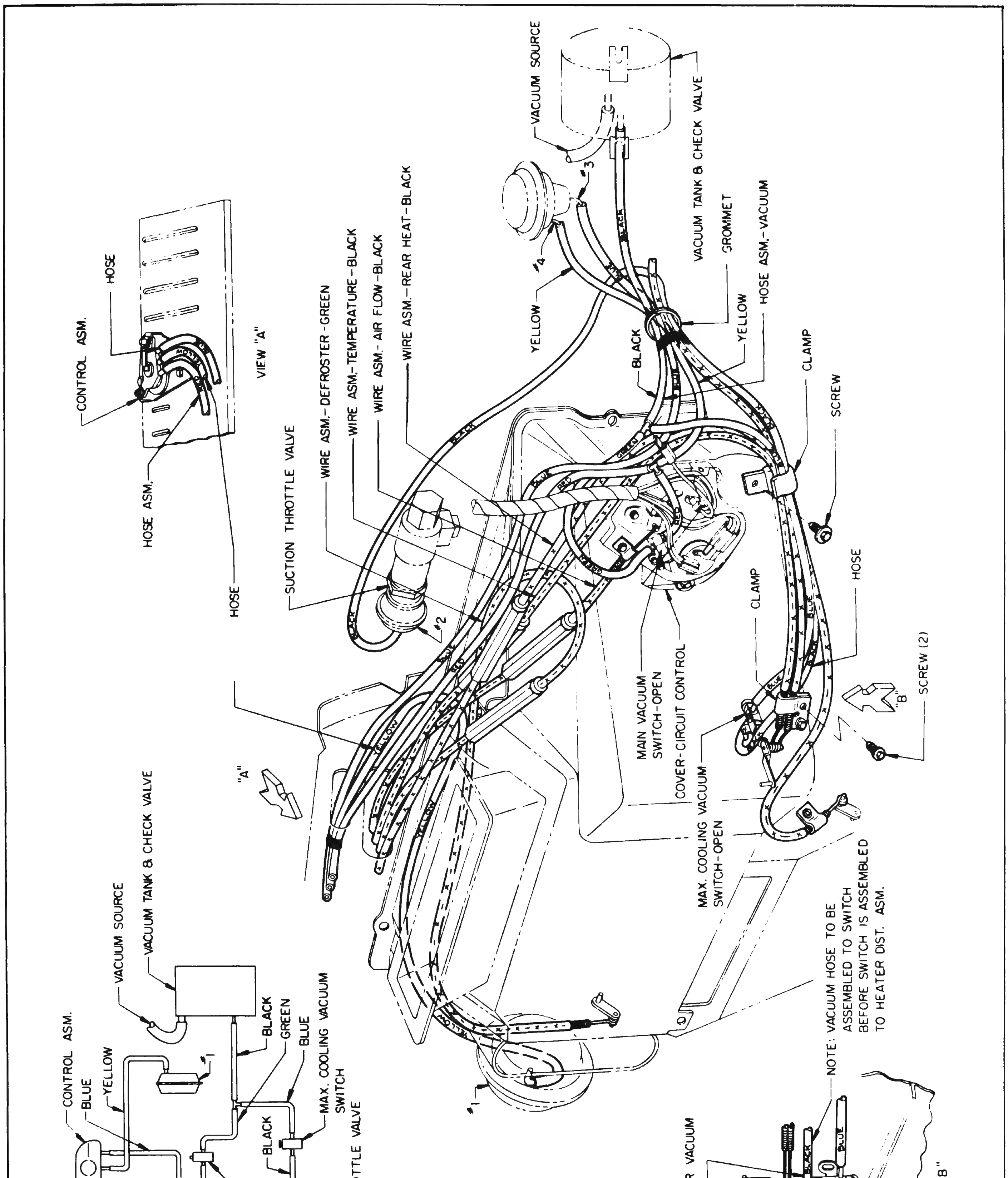


Figure 11-78—Vacuum Hose Installation - 4400, 4600 and 4800 Series

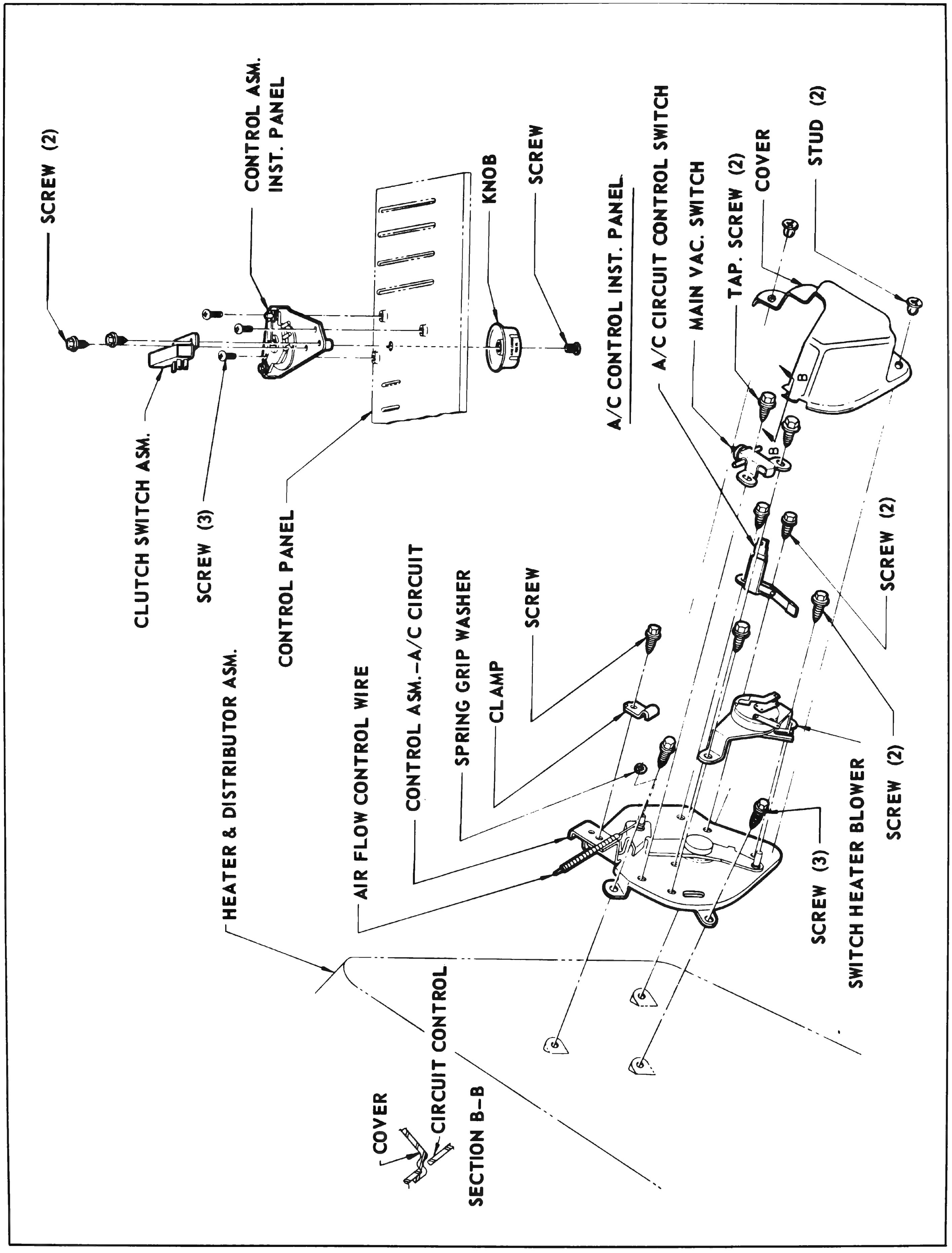


Figure 11-79—Air Conditioner-Heater Circuit, and Climate Control Installation - 4400, 4600 and 4800 Series

e. Air Distribution Chart— 4400-4600-4800 Series

Climate Control Setting	Air Lever	Temp Lever	Vacuum Diaphragm Applied	Main Vacuum Switch	Max. Cooling Vacuum Switch	Air Distribution
Any Position	Off	Off	#2	Closed	Open	None
Heat	On	On	#1, 3, 4	Open	Closed	Heater Outlets
Vent or Air Cond Normal	On	Off	#2, 3, 4	Open	Open	Air Conditioner Outlets
Vent or Air Cond Normal	On	On	#3, 4	Open	Closed	Air Conditioner Outlets
Air Cond Recir	On	Off	#2, 4	Open	Open	Air Conditioner Outlets

f. Trouble Diagnosis— 4400-4600-4800 Series

CONDITION	COMPLAINT	POSSIBLE CAUSE
NOTE: If the vacuum hoses are properly attached (Figure 11-73 and 11-78) and lever control wires properly adjusted (par. 11-17, subpar. ''d''), complaint may be caused by the items listed on this chart.		
AIR Lever off	Air out of Air conditioner outlets or heater outlets.	Check main vacuum switch. (See Figure 11-79).
Climate Control Set at any Position. AIR lever on.	*No air through air conditioner or heater outlets (blower operates).	Main vacuum switch defective. Climate control defective. #3 and #4 dual stage vacuum diaphragm defective.
	*Blower does not operate.	Control circuit switch defective. Blower switch defective. 30 amp fuse on fuse block blown. Blower motor defective.
*When climate control is at VENT or HEAT, AIR lever must be in third, fourth or fifth position for blower to operate.		

CONDITION	COMPLAINT	POSSIBLE CAUSE
Climate Control set at any position, AIR lever on.	Air flow changes or shuts off when car is accelerated.	Defective check valve in vacuum tank or vacuum leak.
Climate Control set at HEAT, AIR lever on.	Air out of air conditioner outlets.	#1 Vacuum diaphragm defective. Climatic control defective.
Climate Control set at AIR COND NORMAL or AIR COND RECIR, AIR lever on.	Compressor fails to operate.	Clutch switch defective.
Climate Control set at AIR COND RECIR, AIR lever on.	No recirculated air.	Climate Control defective. #4 vacuum diaphragm defective.

11-14 AIR DISTRIBUTION SYSTEM OPERATION AND TROUBLE DIAGNOSIS—4700 SERIES

a. System Operation

Two dual stage vacuum diaphragms (see Figure 11-80) and two vacuum disc switches comprise the vacuum circuit for the 4700 Series. One vacuum diaphragm regulates the opening and closing of the heater and evaporator air door, and the other vacuum diaphragm opens and closes the outside and recirculated air door. When vacuum is not present on the dual stage vacuum diaphragm for the outside and recirculated air door, the door is held in the closed position by a spring. Similarly, the heater and evaporator door is held closed and the air flow is directed thru the heater assembly. If vacuum is applied to only one stage of the vacuum diaphragm of the outside and recirculated air door, the door will partially open to the recirculated position. If vacuum is applied to only one stage of the vacuum diaphragm of the heater and evaporator air door, the door will partially open to the heat and A/C position (see Figure 11-86) to permit air flow to both the evaporator and heater assemblies. Application of vacuum to both stages of the vacuum diaphragm for the heater and evaporator air door will draw the door fully open, and duct all air flow to the air conditioner outlets. When vacuum is applied to both stages of the outside and recirculated air door vacuum diaphragm, the door will be drawn fully open and block off all recirculated air flow. The interrelationship between the DEFROSTER, HEATER TEMP and air conditioner temperature control levers, and their affect on the vacuum diaphragms is shown in Figures 11-80 and 11-81. The various positions of the air doors for each mode of operation is shown in Figures 11-82 thru 11-86.

b. Trouble Diagnosis—4700 Series

If the heater-air conditioner system is not functioning properly, first check the vacuum hose connections and the control cable adjustments. If this does not correct complaint, check for vacuum at diaphragms, for proper functioning of vacuum disc switches and position of air doors as shown in Figures 11-82 thru 11-86. Refer to trouble diagnosis chart for possible causes of complaint.

IMPORTANT: If complaint is that air flow changes or shuts off when car is accelerated, check valve at intake manifold may be defective. Also, if there is no vacuum to suction throttle valve (air conditioner temperature control lever is on low), check for the vacuum hoses being off vacuum modulator, hoses being kinked or modulator being defective.

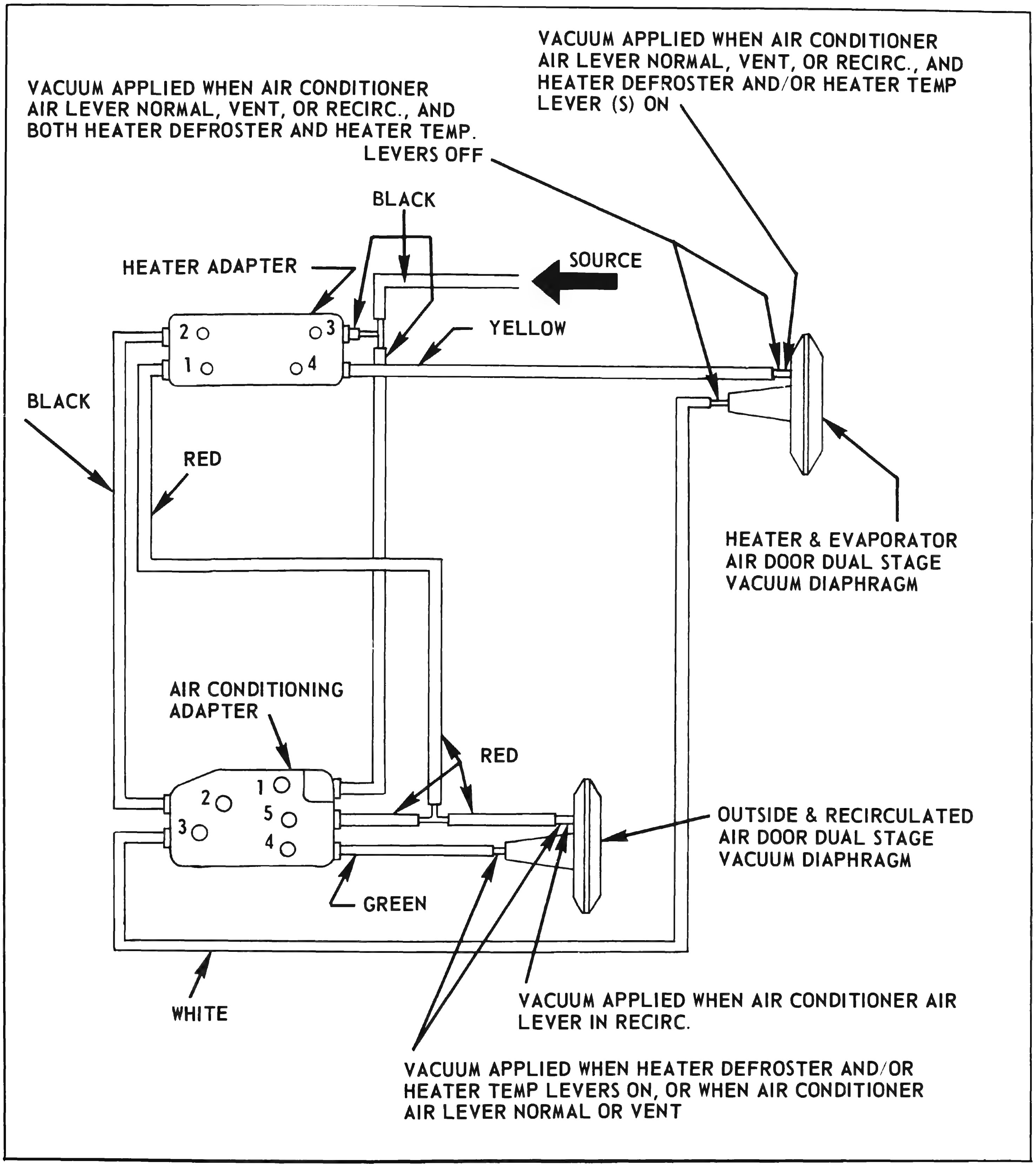


Figure 11-80—Vacuum Circuit

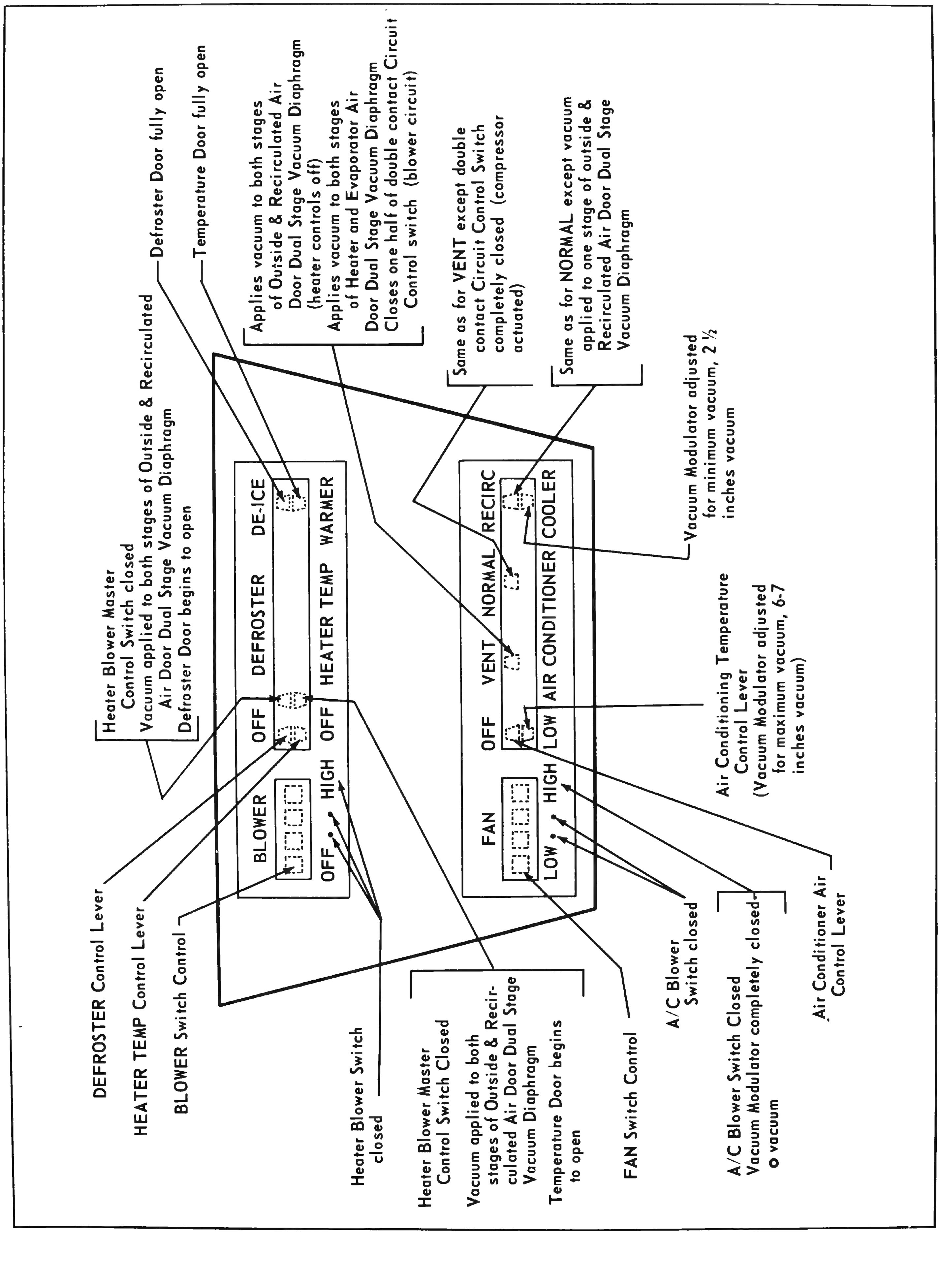


Figure 11-81—Air Conditioner Control Assembly Operation Sequence

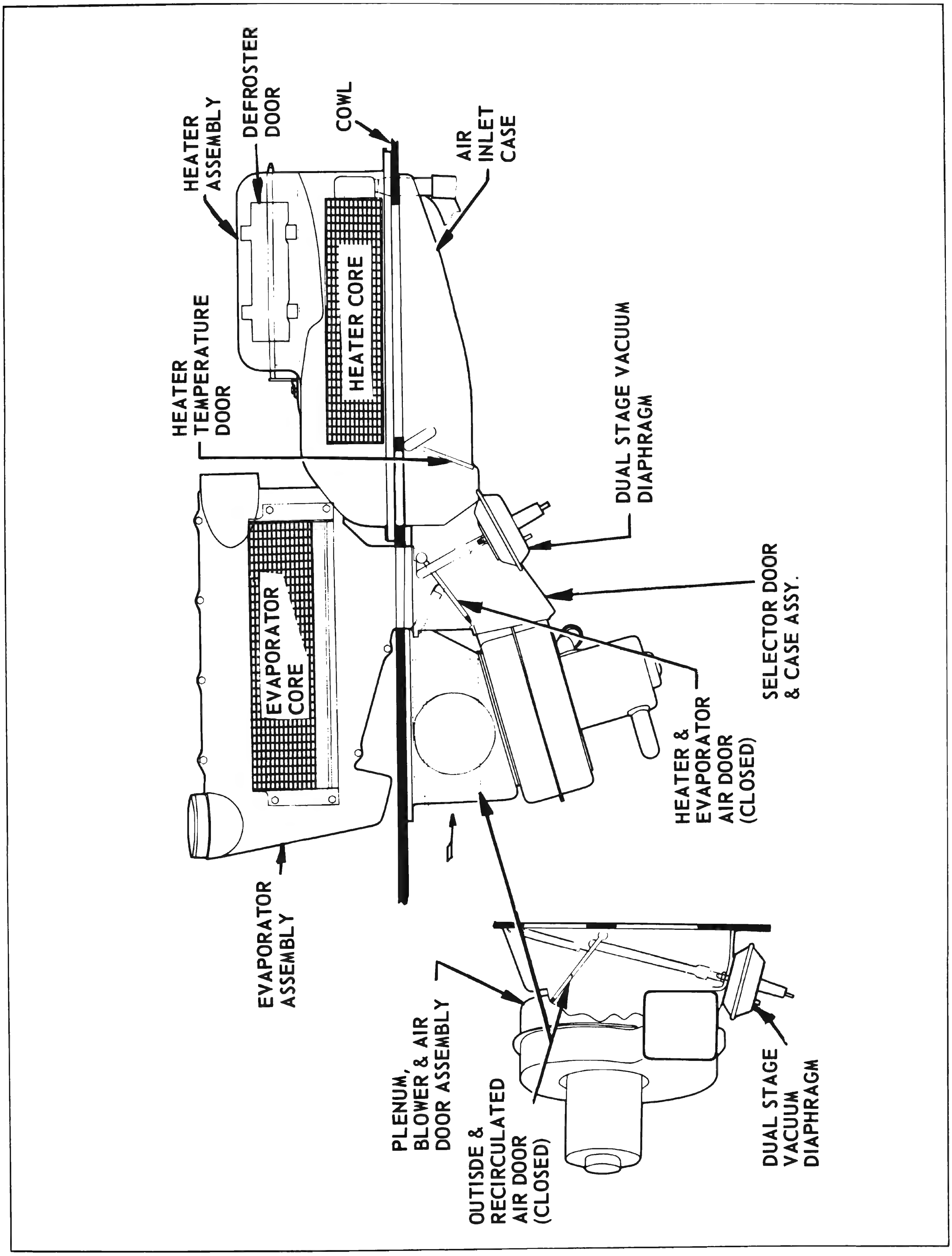


Figure 11-82—Air Conditioner and Heater Off - 4700 Series

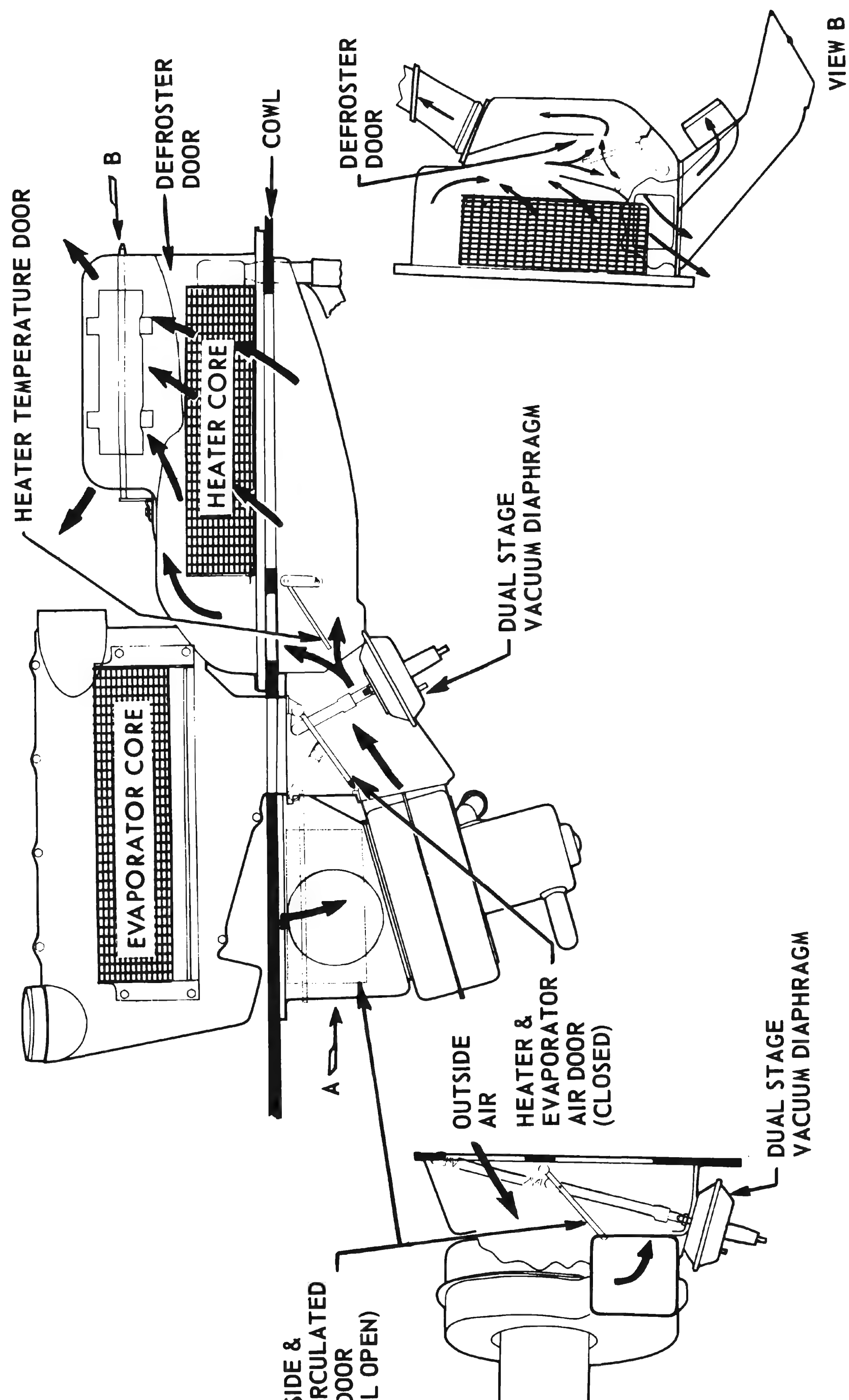


Figure 11-83—Air Conditioner Off, Heater On - 4700 Series

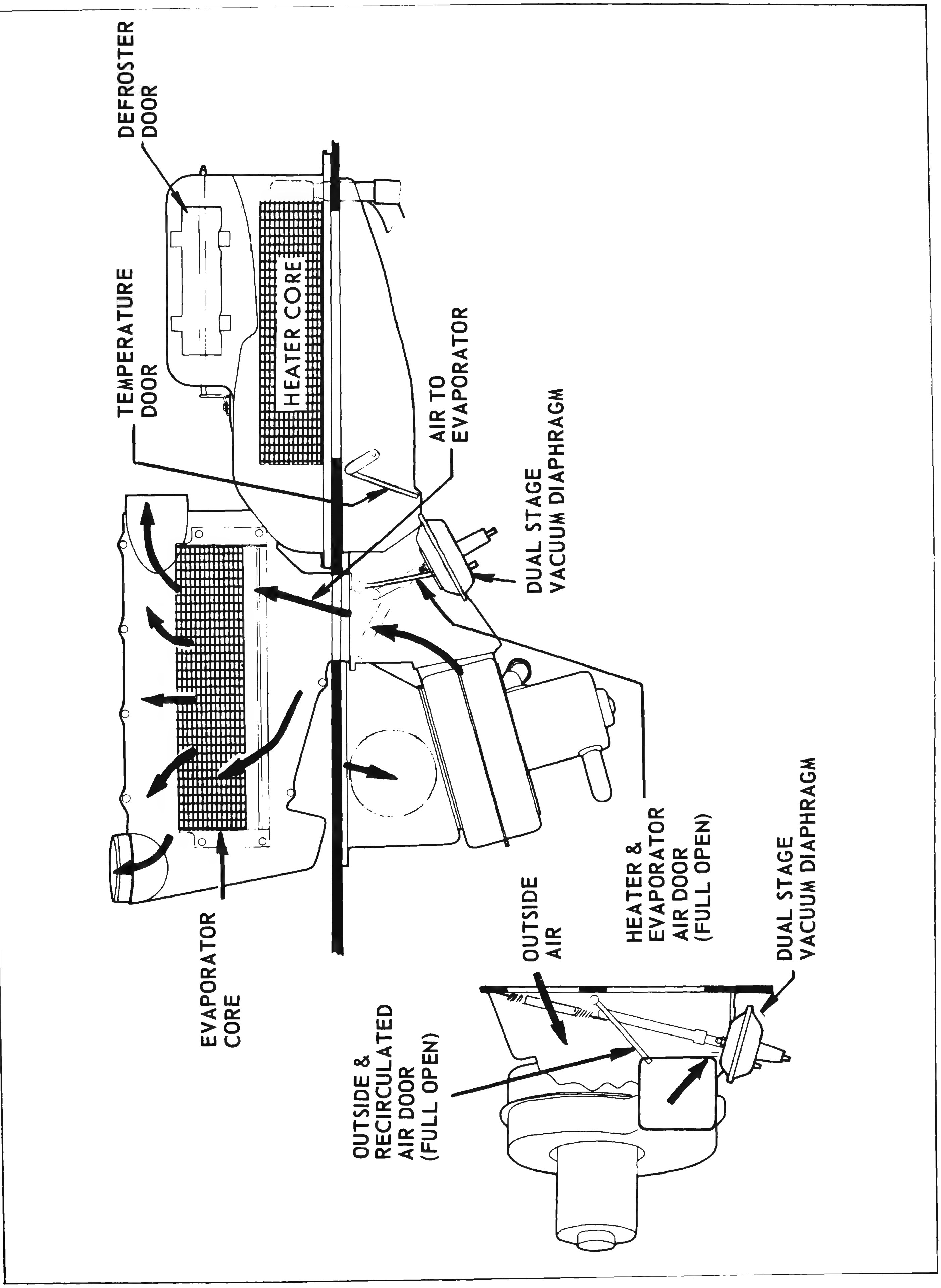


Figure 11-84—Air Conditioner Ventilation or Normal, Heater Off - 4700 Series

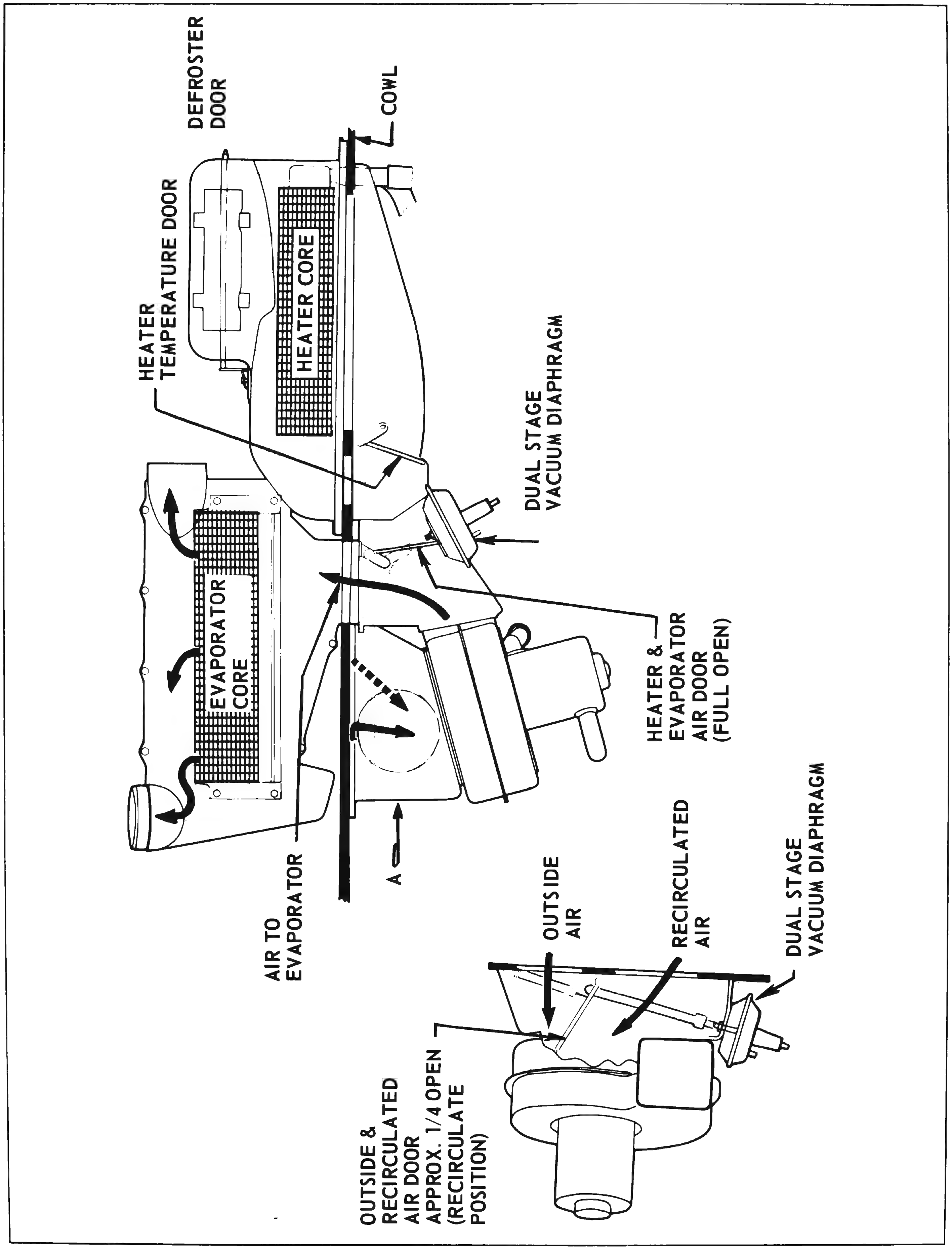


Figure 11-85—Air Conditioner Recirculate, Heater Off - 4700 Series

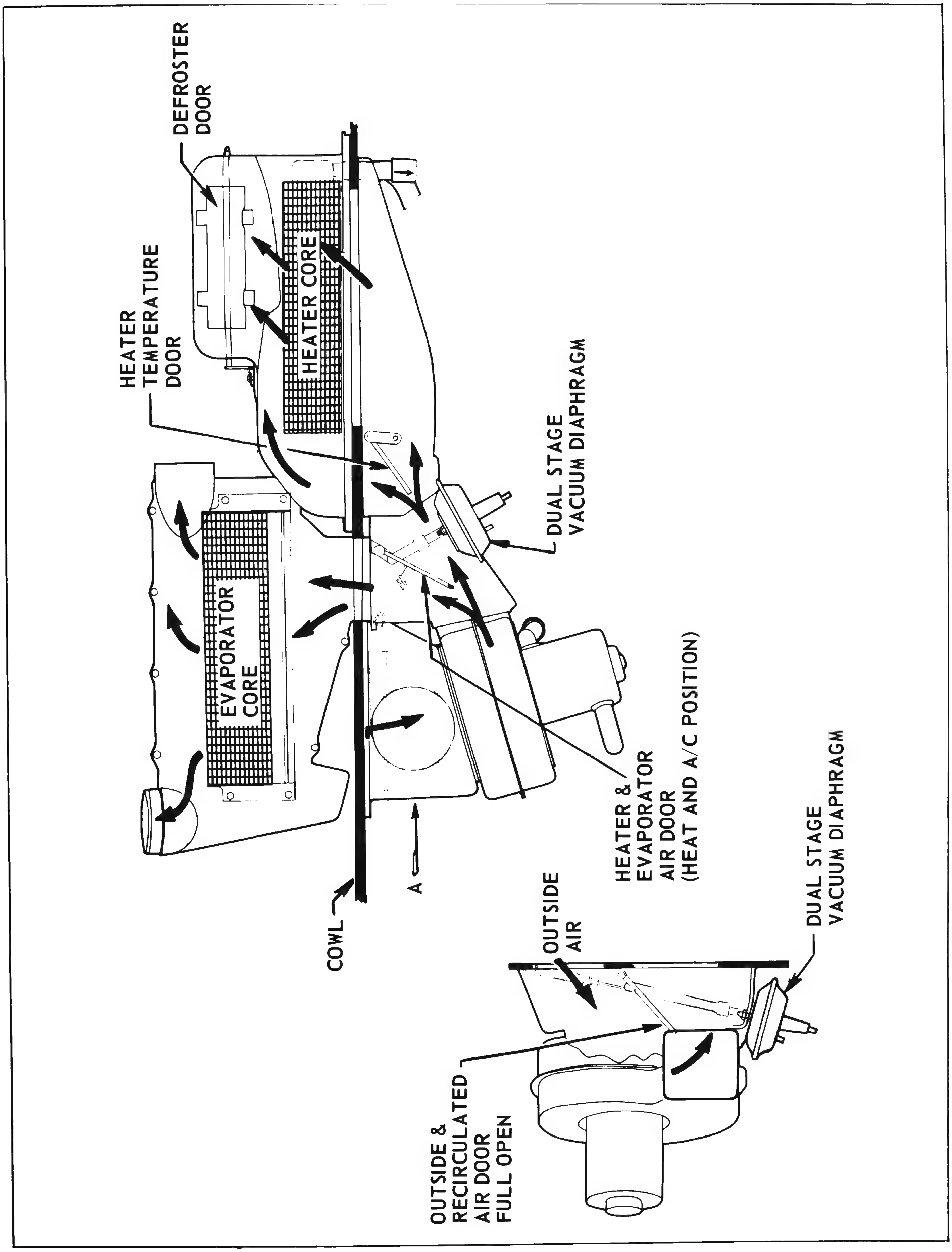


Figure 11-86—Air Conditioner Ventilation or Normal, Heater On - 4700 Series

c. Vacuum Switch Trouble Diagnosis—4700 Series

CONDITION	COMPLAINT	POSSIBLE CAUSE
All controls off.	Air out of A/C outlets.	Check heater and evaporator air door dual stage vacuum diaphragm. No vacuum should be present.
	Air out of heater outlets.	Check outside and recirculated air door dual stage vacuum diaphragm. No vacuum should be present.
Air Conditioner Air Control Lever on.	Recirculated air only - no outside air, windows steam up, air in car stale.	Check outside and recirculated air door vacuum diaphragm. Vacuum should be applied to one or both stages depending on position of lever.
	Air out of heater.	Check that vacuum is applied to both stages of heater and evaporator air door vacuum diaphragm.
Air Conditioner Air Control Lever on NORMAL and Air Conditioner Temperature Control Lever on DEFROSTER and HEATER TEMP levers OFF.	All air out of heater outlets.	No vacuum applied to both stages of heater and evaporator air door vacuum diaphragm. Heater and evaporator air door stuck closed.
	Both recirculated and outside air.	Vacuum applied to only one stage of outside and recirculated air door vacuum diaphragm.
	Air out of A/C and heater outlets.	Check for defective heater vacuum disc switch.
Air Conditioner Air Control Lever on RECIRC.	No recirculated air.	Defective air conditioner vacuum disc switch.
Air Conditioner Air Control lever RECIRC and DEFROSTER and/or HEATER TEMP Control Levers on.	All air through heater outlets.	Check for defective vacuum diaphragm.
	All air through A/C outlets.	Check for defective heater vacuum disc switch.

11-15 SERVICE PROCEDURES

IMPORTANT: If a receiver-dehydrator is replaced, the port of the receiver-dehydrator marked "IN" must be attached to condenser outlet.

NOTE: See paragraphs 11-16 and 11-17 for service procedures on compressor assembly.

a. Safety Precautions

The following safety precautions should always be used when servicing the air conditioner refrigeration system.

1. Do not leave drum of Refrigerant-12 uncapped.

2. Do not carry drum in passenger compartment of car.

3. Do not subject drum to high temperature.

4. Do not weld or steam clean near system.

5. Do not fill drum completely.

6. Do not discharge refrigerant vapor into area where flame is exposed, or do not discharge directly into engine air intake.

7. Do not expose eyes to liquid refrigerant; always wear safety goggles.

b. Installation Precautions

All subassemblies are shipped sealed and dehydrated. They are to remain sealed until just prior to making connections.

2. All subassemblies should be at room temperature before uncapping. This prevents condensation of moisture from air that enters the system.

3. All precautions should be taken to prevent damage to fittings or connections. Even minute damage to a connection could cause it to leak.

4. Any fittings with grease or dirt on them should be wiped clean with a cloth dipped in alcohol. Do not clean fittings or hoses with chlorinated salts such as trichlorethylene, as they are contaminants. If dirt, grease or moisture gets inside the pipes and cannot be removed, the pipe is to be replaced.

5. Use a small amount of refrigeration oil on all tube and hose joints and lubricate the "O" ring seal in this oil before assembling the joint as this oil will help in making a leakproof joint. When tightening joints, use a second wrench to hold the stationary part of the connection to prevent twisting, and to prevent hose kinking as kinked hoses are apt to transmit noise and vibration.

CAUTION: Tighten all connections in accordance with recommended torques. See pipe and hose connection chart. See Figure 11-42. Insufficient torque when tightening can result in loose joints. Over-tightening can result in distorted joint parts, and either condition can result in refrigerant leakage.

6. Do not connect receiver-dehydrator assembly until all other seals of assemblies have been connected. This is necessary to insure optimum dehydration and maximum moisture protection of the system.

c. Discharging Refrigerant From Air Conditioner System

When a part is removed or disconnected that is in the Air Conditioner refrigeration circuit, the refrigerant must be discharged from system using the following procedure.

1. Remove protective caps from Schrader valve gauge fittings on suction throttle valve and discharge line located at rear of compressor.

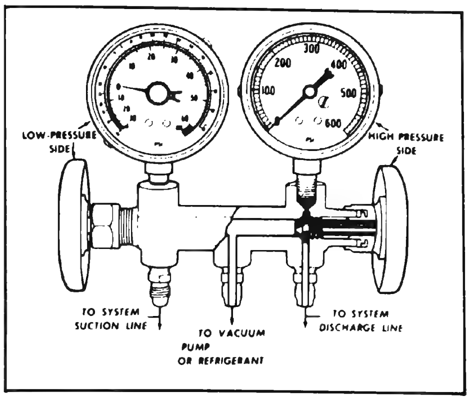


Figure 11-87—Manifold and Gage Set, J-5725-01

2. Using Adapters J-5420, connect charging lines of pressure gauge and set Manifold and Gauge Set J-5725-01 (see Figure 11-87) to Schrader valves as shown in Figure 11-153 with both valves of manifold closed.

3. Slowly open valves on manifold and discharge all pressure from system.

CAUTION: Do not open valves too fast as excessive oil will be blown out of system. Place rag over end of discharge service line to prevent oil or liquid refrigerant from spraying on car or person.

d. Adjustments—4400-4600-4800 Series

There is no service adjustment on the blower switch, the expansion valve, the circuit switch or the climate control.

1. Control Wire Adjustment - The air conditioner - heater wires are adjusted by rotating the adjuster nuts which are part of the control wire assembly.

To adjust any of the control wires, set control levers in off position. Then rotate the adjuster so that the lever on instrument panel is 1/8" from full off position. See Figure 11-78.

IMPORTANT: Always recheck adjustment, by again placing valve or control in off position of control lever. Lever should be 1/8"

from off position and lined up.

When adjusting TEMP wire be sure manual water valve (see Figure 11-88) is in the off position.

2. Main Vacuum Switch Adjustment - Place AIR lever in off position. Loosen main vacuum switch attaching screws and push switch against control lever on circuit control assembly to fully depress plunger. Tighten mounting screws. See Figure 11-89.

3. Max. Cooling Vacuum Switch Vacuum - Place temperature door and TEMP lever in off position. Loosen Max. cooling vacuum switch retaining screws and push switch against temperature door lever to fully depress switch plunger. Tighten mounting screws.

e. Adjustments—4700 Series

There is no service adjustment on the blower switches, the expansion valve vacuum modulator, vacuum diaphragms or vacuum disc switches on 4700 Series cars.

Adjustments for the control wires attached to the heater control assembly are the same as for non-air conditioned cars (ref. to par. 11-8 and see Figure 11-90).

f. Suction Throttle Valve Adjustments

IMPORTANT: The suction throttle valve adjustment is to be made only after the functional test shows evaporator pressure significantly different from the chart.

1. Have a service gauge set connected to Schrader valves as shown in Figure 11-153.

2. Set controls for maximum cooling, heater off, ventilators closed and all air conditioner outlets open.

(a) On 4400-4600-4800 Series the climate control is set at Air Cond. Recir. and air lever full on, TEMP lever must be off.

(b) On 4700 Series the Air Conditioner Air Control, Temperature Control, and Fan switch levers are set full on. Heater Temp and Defroster levers are set to OFF.

3. Engine set at 2000 RPM.

4. Remove the vacuum hose from the 4700 suction throttle vacuum diaphragm. Do not remove hose from the 4400, 4600 or 4800 diaphragm.

5. Three minutes after the valve has started to control, check the gauge readings and outlet temperature against the functional test chart.

6. If necessary to adjust STV, loosen the large lock nut on sleeve of suction throttle valve vacuum diaphragm.

7. To adjust valve, rotate diaphragm assembly clockwise to increase evaporator pressure and counterclockwise to decrease pressure.

8. After adjusting the valve, observe operation of the system for a few minutes to check readings.

9. Tighten lock nut on sleeve and reinstall the vacuum hose on the 4700 vacuum diaphragm.

10. Check operation of suction throttle valve.

(a) On 4400-4600-4800 Series, move the TEMP lever a short distance forward from the off position. There should be no vacuum to the vacuum diaphragm of the valve.

With the Temp lever in this position, the evaporator pressure should raise by approximately three psi. If the evaporator pressure does not increase, check the adjustment of the Temp lever wire and Max. cooling vacuum switch at the temperature valve, improper vacuum hose connections or kinked vacuum hoses. If these are correct, the suction throttle valve is defective and should be repaired.

(b) On 4700 Series, move the Air Conditioner Air Control lever to normal position and the temperature control and Fan switch levers to Low.

With the levers in this position, the evaporator should raise to approximately 50 psi. Return the levers to full on and recheck setting of the suction throttle valve.

If the 4700 evaporator pressure does not increase when Air Conditioning Temperature Control and Fan lever are at Low, check operation of vacuum modulator by connecting a vacuum gauge to the hose that goes to the STV. The modulator should regulate manifold vacuum from 6 to 7 inches when the temperature control lever is moved from the Low position to 0 inches when the temperature control and Fan switch levers are respectively in the cooler and high position. If modulator does not function properly, check vacuum hose connections, check for kinked hose or for defective modulator.

g. Removal and Installation of Suction Throttle Valve

1. Discharge refrigerant from system as described in subparagraph "c".

2. Disconnect lines from valve.

3. Remove valve mounting screws and remove valve.

NOTE: All of the openings to the air conditioning system should be capped or plugged during the time the STV is removed.

4. Install valve by reversing procedure for removal, paying attention to the following:

(a) Install new "O" rings on line fittings.

(b) The valve piston must be lubricated with 525 compressor oil

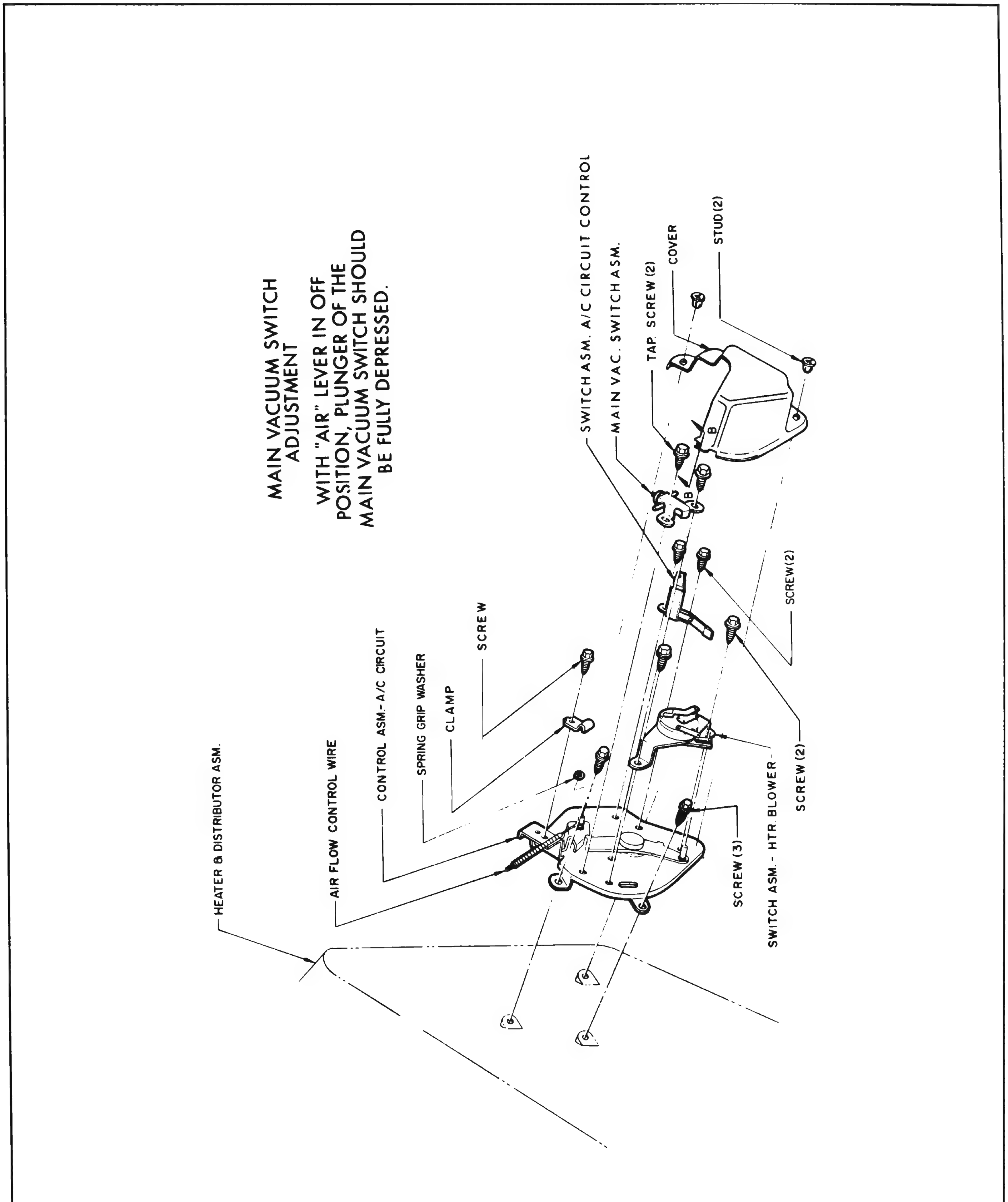


Figure 11-88—Manual Water Valve and Hose Installation - 4400, 4600 and 4800 Series

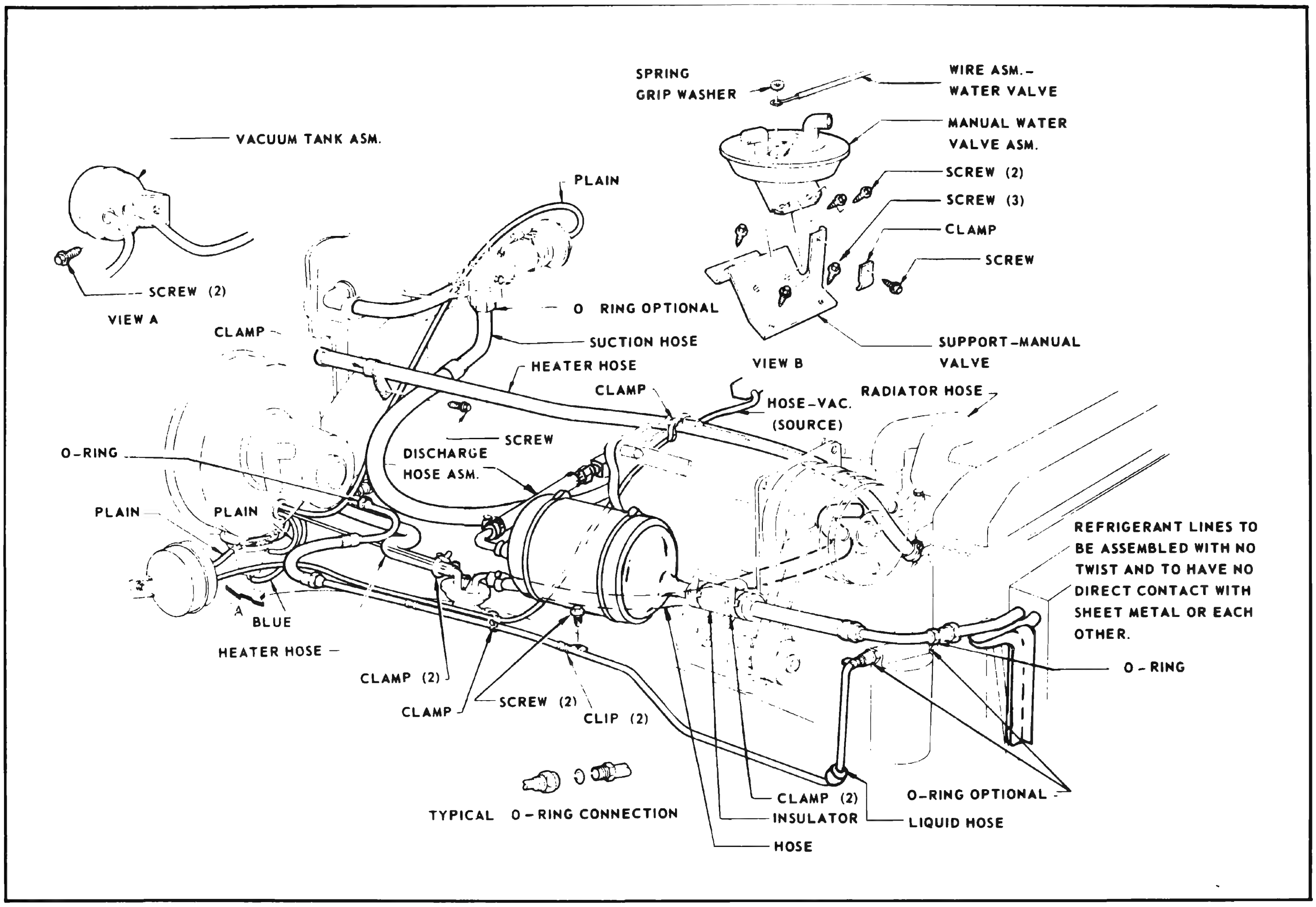


Figure 11-89—Main Vacuum Switch Adjustment - 4400, 4600 and 4800 Series

through line connections to prevent piston from sticking on initial operation.

(c) Evacuate and charge the system. Leak test valve and connections. Correct any leaks.

(d) After system has been charged, on 4700 move air conditioning temperature control lever from one extreme to the other about 12 times with system operating to normalize the valve diaphragm.

(e) Check operation of the suction throttle valve, refer to subparagraph "f".

h. Disassembly and Assembly of Suction Throttle Valve

If test indicated suction throttle valve is defective, the valve should be overhauled as follows:

1. With valve removed from car, loosen lock nut on vacuum diaphragm and turn diaphragm assembly out of cover. On 4700 valve, discard "O" ring on sleeve of diaphragm. See Figure 11-91.

NOTE: Figure 11-91 shows the 4700 series suction throttle valve. The 4400, 4600 and 4800 suction throttle valve is basically the same except a different diaphragm is used and an "O" ring is not used on the vacuum diaphragm.

2. Remove spring from cover.

3. Remove the five screws that retain cover to body of valve and remove cover.

4. Remove diaphragm and piston assembly.

5. Remove retainer cup from diaphragm.

The diaphragm should be handled with care to avoid damage by scuffing, cutting or abrading the rubber and fabric surfaces. The piston diaphragm or the screen and retainer in the lower portion of the piston should not be removed. The screen should, however, be examined for any foreign material or contamination. If necessary clean screen with a volatile solvent. All solvent should be removed from parts after cleaning.

In the event the exterior surface of the piston is damaged such as scored, scratched or nicked, in such a way as to cause it to bind in the bore, it should be replaced.

NOTE: It is recommended that no attempt be made to scrap,

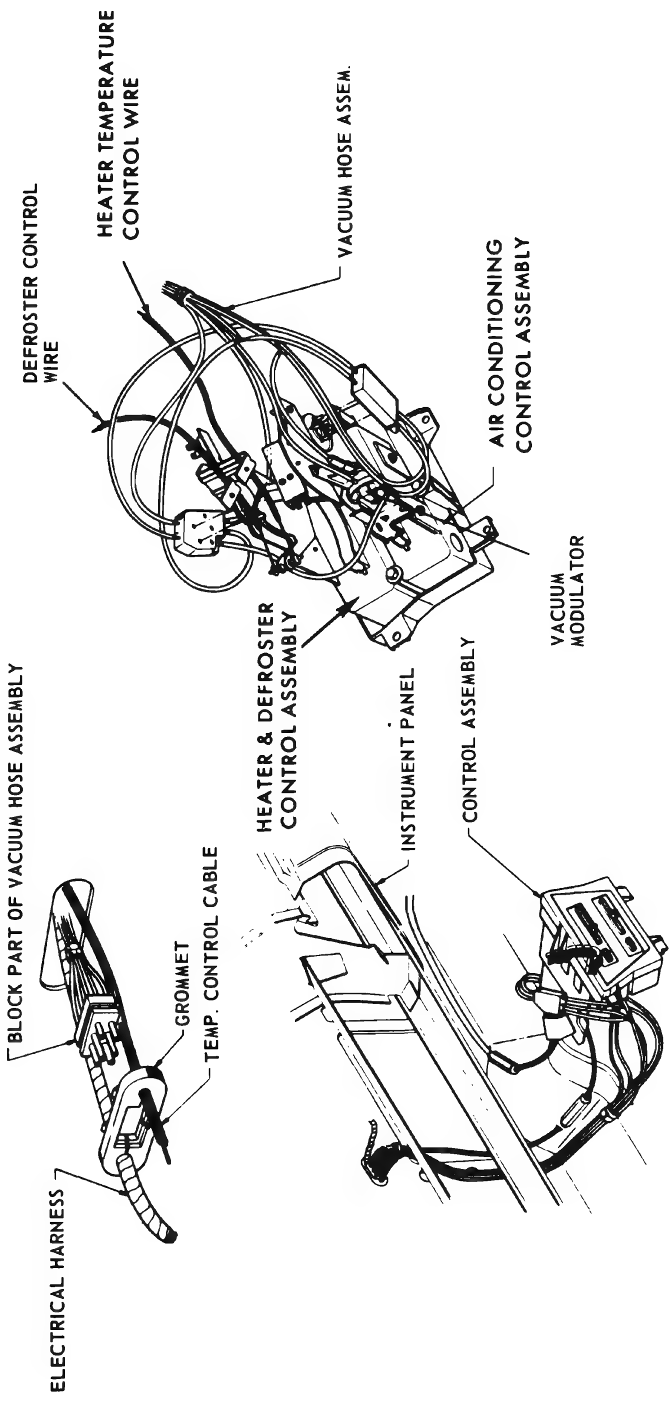


Figure 11-90—Vacuum Hose Installation - 4700 Series

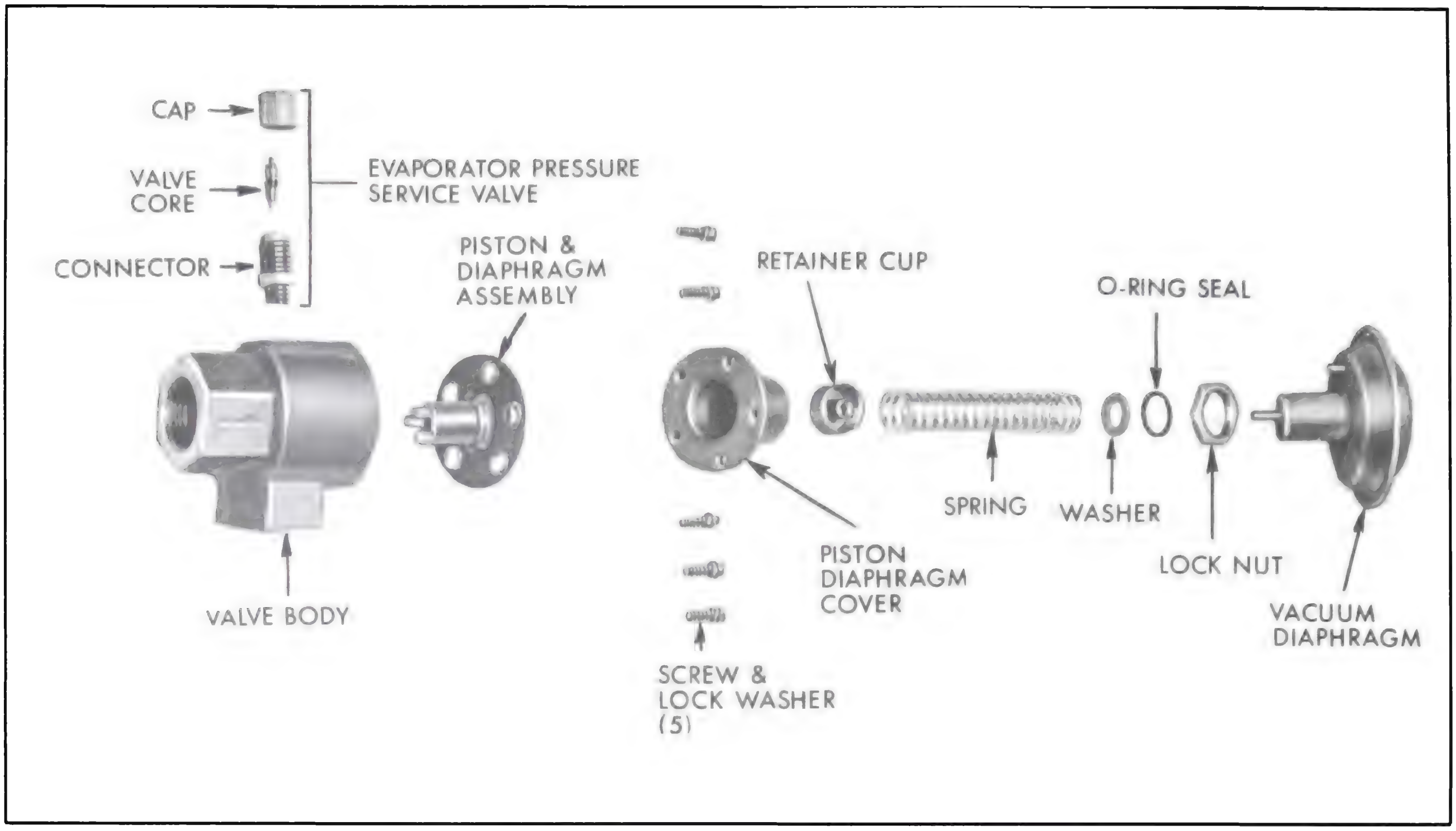


Figure 11-91—Suction Throttling Valve (Exploded View) - 4700 Series

stone or crocus cloth these damaged areas due to the close tolerance that is required in the fitting of the parts for proper operation. In the event the diaphragm is found to be damaged, the piston assembly should be replaced. A very light application of powdered Molykote Type Z should be applied to the upper or fabric surface of the depressed section of the new diaphragm where the spring retainer cup will fit into it.

NOTE: The source for the material is: Alpha-Molykote Corporation Stamford, Connecticut. No other material is recommended.

Examine the body bore surfaces for any surface imperfections, foreign material and any obvious damage that would cause the piston to not operate freely. The body should be replaced if the bore is damaged or if any cross threading or damage has been sustained around the connector parts.

6. Apply a light coat of 525 viscosity oil to the wall of the piston and insert it into the body of the valve.

7. Assemble the retainer cup to the diaphragm and place the cover in proper location over the diaphragm being sure the diaphragm holes are in line with the locating protrusions under the cover flange. Start the five screws into the body, but DO NOT TIGHTEN.

8. With the cover and body held loosely in one hand, insert a clean smooth rod, approximately 3/8" in diameter, through the inlet opening so as to contact the screen retainer in the bottom of the piston.

Carefully push the piston into the cover so that the diaphragm positions properly into the cavity of the cover and does not become pinched under the flange.

Remove the rod from the inlet opening and insert it through the upper portion of the cover. It should contact the center post of the cup. Press lightly downward so as to cause the piston to seat against the inner shoulder of the body. While the cup, diaphragm and piston are held down, tighten the five screws to 45 to 50 inch pounds torque.

9. Place locknut on vacuum diaphragm and install a new "O" ring on diaphragm.

NOTE: 4400-4600-4800 valve diaphragm does not use an "O" ring.

10. Insert washer and spring in vacuum diaphragm.

11. Reassemble vacuum diaphragm cover and screw in approximately ten turns.

12. Install suction throttle valve as described in subparagraph "g" and adjust as described in subparagraph "f".

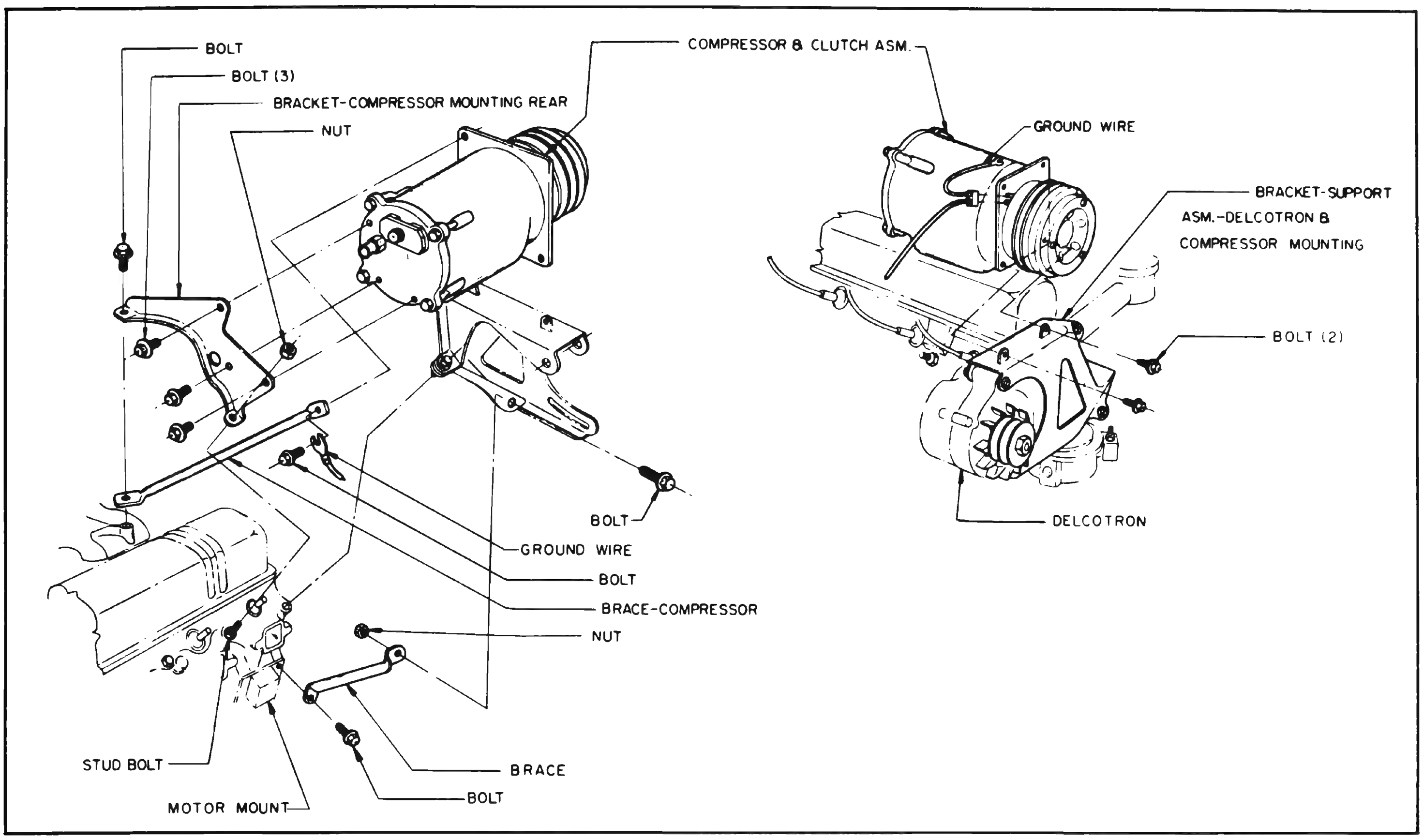


Figure 11-92—Compressor Installation - 4600, 4700 and 4800 Series

i. Removal and Installation of Compressor

1. Discharge refrigerant from system as described in subparagraph "c".

2. Remove center bolt to remove Schrader valve retaining plate from rear end of compressor.

3. Cover the openings in lines and compressor with tape to exclude dirt.

4. Disconnect magnetic clutch coil wire connector, then loosen the belts and remove compressor from its mounting on engine. See Figures 11-92 and 11-93.

Do not place compressor in sun or near heat because it still contains some refrigerant.

IMPORTANT: Whenever a compressor replacement is being made the oil in the original compressor should be drained and measured. The new compressor should contain the same amount of new 525 viscosity oil as was drained from the original compressor. This step is necessary as some of the oil from the original compressor remains in the system. The addition of a complete change of oil, in addition to the oil remaining in the system, would impair the cooling ability of the unit.

CAUTION: If it is evident that the air conditioner has lost a large amount of oil, refer to subparagraph "j" for procedure for adding oil to compressor.

5. Install compressor by reversing procedure for removal, paying attention to the following points:

(a) Inspect drive belts and pulley grooves for conditions that might cause slippage. If a belt is cracked, frayed, or oil soaked, or is worn so that it bottoms in pulley grooves, replace both belts. Belts are furnished in matched sets to insure even tension.

(b) Use new "O" rings when attaching valve assemblies to compressor.

(c) Adjust compressor belt tension. See Figures 2-47 and 2-48.

(d) Evacuate, leak test and charge air conditioner system (par. 11-18) air conditioner system (par. 11-18).

j. Checking Compressor Oil and Adding Oil

The six cylinder air conditioner compressor is initially charged with 10-1/2 fluid ounces of 525 viscosity Frigidaire Refrigerant oil. After the air conditioner system has been operated, oil circulates throughout the system with the refrigerant. Hence, while the system is running, oil is leaving the compressor with the high pressure gas and is returning to the compressor with the suction gas.

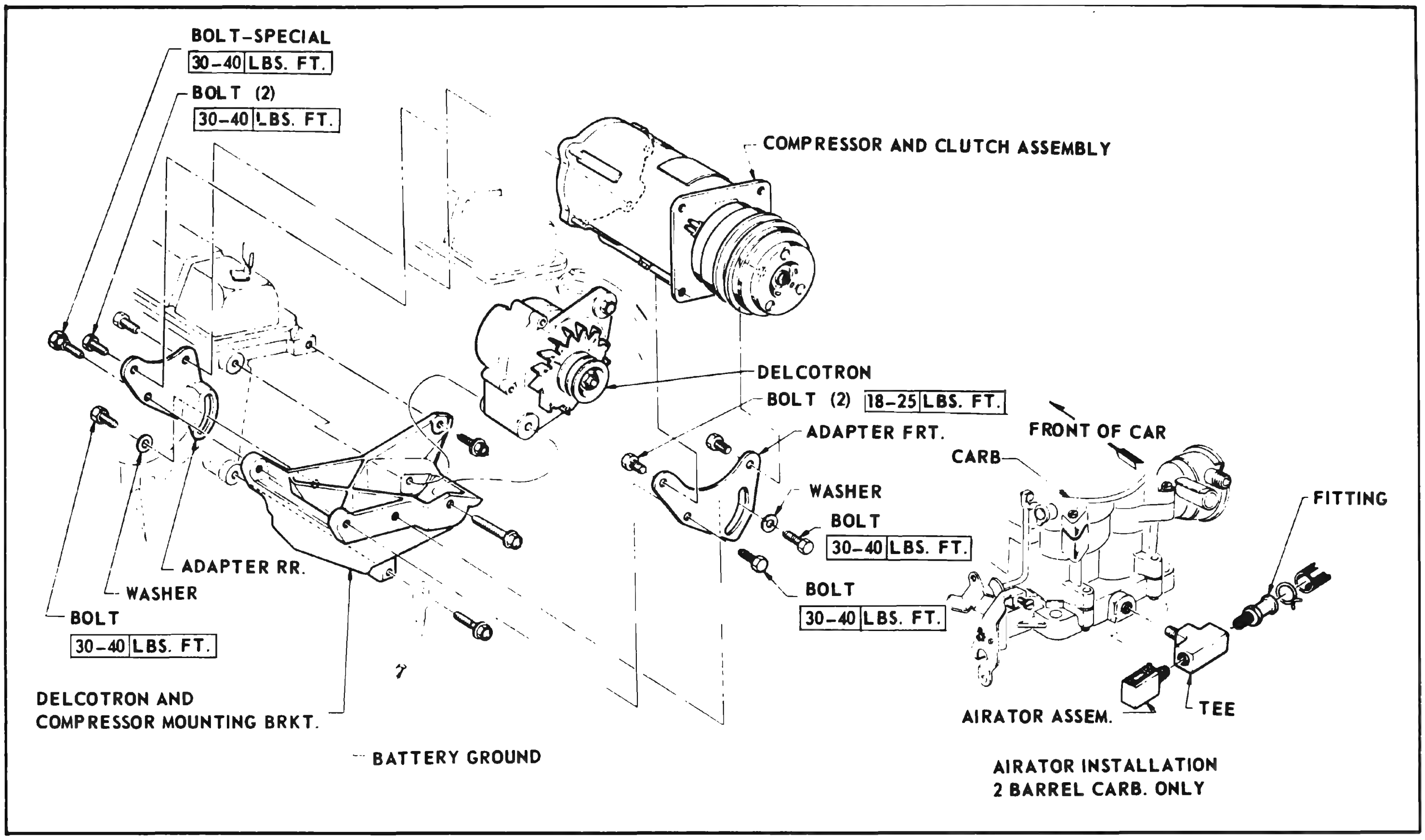


Figure 11-93—Compressor Installation - 4400 Series

When the air conditioner is operated around 1000 to 1500 engine rpm's, in the maximum cooling position and blower on high, approximately 4 ounces of oil remains in the compressor while the rest is distributed in the various air conditioner components. At high engine rpm's, a lesser amount of oil will be retained in the compressor (as little as 2 ounces of oil which is adequate for lubrication of compressor).

The oil balance in the system has been carefully established. It is important in any servicing operations to neither add or subtract oil which would cause the total oil change in the system to vary from 10-1/2 fluid ounces. If the total oil change is less, lubrication of the compressor may not be adequate; if too much oil is in the system, this will reduce the refrigerating capacity of the system. The compressor oil cannot be checked while the compressor is installed on the car.

The oil level in the compressor should not be checked as a matter of course such as is done in the car engine crankcase. The compressor oil level should be questioned only in cases where there is evidence of a major loss of system oil such as:

1. Broken hose or severe hose fitting leak.

2. Oil sprayed in large amounts under the hood due to a very badly leaking compressor seal.

3. Collision damages to system components.

To check the oil and to determine amount to install in compressor, the compressor must be removed and drained. This same procedure is used to determine amount to install in a replacement compressor, or in a compressor that has been disassembled for repair.

To drain compressor, remove drain plug and place compressor in a horizontal position with drain plug opening downward. Allow all oil to drain into a container, measure total amount, then discard oil. To determine the amount of oil that should be installed in the compressor if there has been a major loss of oil, when replacing a compressor with a service compressor; or when compressor has been disassembled and rebuilt, use the following chart.

IMPORTANT: If oil drained from compressor contains any foreign materials such as chips, or there is evidence of moisture in the system, it will be necessary to replace receiver-dehydrator and flush the other component parts with Refrigerant-12 (subpar. 1). The full charge of 10-1/2 oz. of oil should then be added to compressor.

NOTE: The service compressor will also contain 10-1/2 oz. of 525 oil. In most cases, it will be necessary to drain all of the oil from the service compressor, then install oil so that it will be the required amount determined by the chart.

During normal service operations where a condenser, receiver or evaporator is replaced with a new unit and where no major loss of oil is involved, add oil to the new unit per item 1 on chart. The oil can be poured directly into the part being replaced.

CONDITION	AMOUNT OF OIL DRAINED FROM COMPRESSOR	AMOUNT OF 525 OIL TO INSTALL IN COMPRESSOR
1. Major loss of oil and a component has to be replaced.	a. More than 4 oz. b. Less than 4 oz.	a. Amount drained from compressor plus amount for component being replaced as follows: Evaporator - Add 3 oz. Condenser - Add 1 oz. Receiver Dehydrator - Add 1 oz. b. Install 6 oz. plus amount for component being replaced as shown above.
2. Compressor being replaced with a service compressor and there wasn't a major loss of oil from the air conditioner system.	a. More than 1-1/2 oz. (See Note) b. Less than 1-1/2 oz.	a. Same amount as drained from compressor being replaced. b. Install 6 oz.
3. Same as Step 2 except there has been a major loss of oil.	a. More than 4 oz. b. Less than 4 oz.	a. Same amount as drained from compressor being replaced. b. Install 6 oz.
4. Compressor has been inoperative and rebuilt and there wasn't a major loss of oil from air conditioner system.	a. More than 1-1/2 oz. (See Note) b. Less than 1-1/2 oz.	a. Same amount as drained from compressor plus 1 oz. additional. b. Install 7 oz.
5. Same as Step 4 except there has been a major loss of oil.	a. More than 4 oz. b. Less than 4 oz.	a. Same amount as drained from compressor plus 1 oz. additional. b. Install 7 oz.

NOTE: If more than 1-1/2 oz. of clean oil was drained from compressor and there is little or no signs of oil being lost from system, install this amount of oil in replacement compressor (plus 1 oz. additional in repaired compressor).

k. Flushing Air Conditioner System

Flushing the air conditioner system can be accomplished by connecting a refrigerant drum to the unit to be flushed, and then turning the drum upside down and opening the drum shut-off valve to pour refrigerant through the unit. The unit should be supported so that the refrigerant passing through it will be directed into an area where a temperature of -21.7°F. will do no damage. When a unit is not removed such as a condenser, disconnect the inlet and outlet lines before flushing it out.

CAUTION: When liquid refrigerant is poured from the drum into an area where atmospheric pressure exists, its temperature will immediately drop to -21.7°F.

In order to keep the expansion valve open when flushing the evaporator with refrigerant, the expansion valve bulb must be detached from the evaporator outlet tube.

In all cases where it is necessary to flush the air conditioner system, the receiver-dehydrator should be replaced. Also, the expansion valve inlet screen should be cleaned.

Dry nitrogen which is much less expensive than refrigerant, is preferred, if available, for flushing out the air conditioner system. Nitrogen will not cause the temperature to drop as refrigerant-12 does. The cold temperatures make it difficult to remove the contaminated oil from the unit being flushed. Also, the dry nitrogen will remove moisture from the sytem.

l. Removal of Evaporator Assembly and Air Distribution Parts

Figures 11-94 and 11-95 show the installation of the evaporator assembly and air distribution system on the 4400-4600-4800 Series.

Figures 11-96 and 11-97 show the installation of the 4700 Series evaporator and air distribution system.

To remove the evaporator assembly on the 4700, remove the brackets that retain assembly to instrument panel. Then disconnect assembly from distribution duct and right outer outlet, and lower assembly down from under instrument panel. Complete removal by disconnecting lines from evaporator assembly.

When reinstalling assembly be sure to properly install drain hoses and use new "O" rings on refrigerant lines. See Figure 11-97.

To remove distribution duct to service heater core on 4700, lower evaporator assembly from instrument panel. Then disconnect distribution duct, and remove from right side of instrument panel.

11-16 COMPRESSOR CLUTCH COIL AND SHAFT SEAL REMOVAL AND INSTALLATION

It is not necessary to remove compressor from refrigeration system to service clutch parts. It may be necessary to loosen it on its mounting to remove clutch pulley.

CAUTION: Never stand compressor on pulley end.

a. Clutch Drive Plate Removal

1. Hold the clutch drive plate hub with J-9403 wrench and use J-9399 special thin wall 9/16" socket to remove shaft nut. See Figure 11-98.

2. Screw threaded Hub Puller J-9401 into the drive plate hub. Hold body of tool with a wrench and tighten the center screw to remove clutch drive plate. See Figure 11-99.

3. Remove clutch hub key from compressor shaft or from clutch drive plate hub.

4. Remove clutch drive plate assembly retainer ring, using J-5403 No. 21 Truarc Pliers. See Figure 11-100. Remove spacer from inside hub of clutch drive plate.

b. Clutch Drive Plate Installation

1. Insert clutch hub key into hub of clutch drive plate so it projects approximately 3/16" out of end of keyway. See Figure 11-101.

2. Line up key in hub with keyway and position clutch drive plate on shaft.

3. Place Spacer J-9480-2 on Clutch Drive Plate Installer J-9480-1 and thread installer on end of compressor shaft. See Figure 11-102. Press the clutch drive plate on shaft until there is approximately 3/32" space between the friction faces of the drive plate and pulley as shown in Figure 11-102.

4. Remove installer and insert spacer inside clutch drive plate hub.

5. Install clutch drive plate retainer ring with flat side of ring facing spacer, using J-5403, No. 21 Truarc Pliers.

6. Install a new shaft nut, using J-9399, special thin wall 9/16" socket. Tighten to 15 lb. ft. torque. The air gap between the friction faces of the pulley and clutch drive plate should now be between 1/32" and 1/16" clearance. See Figure 11-103.

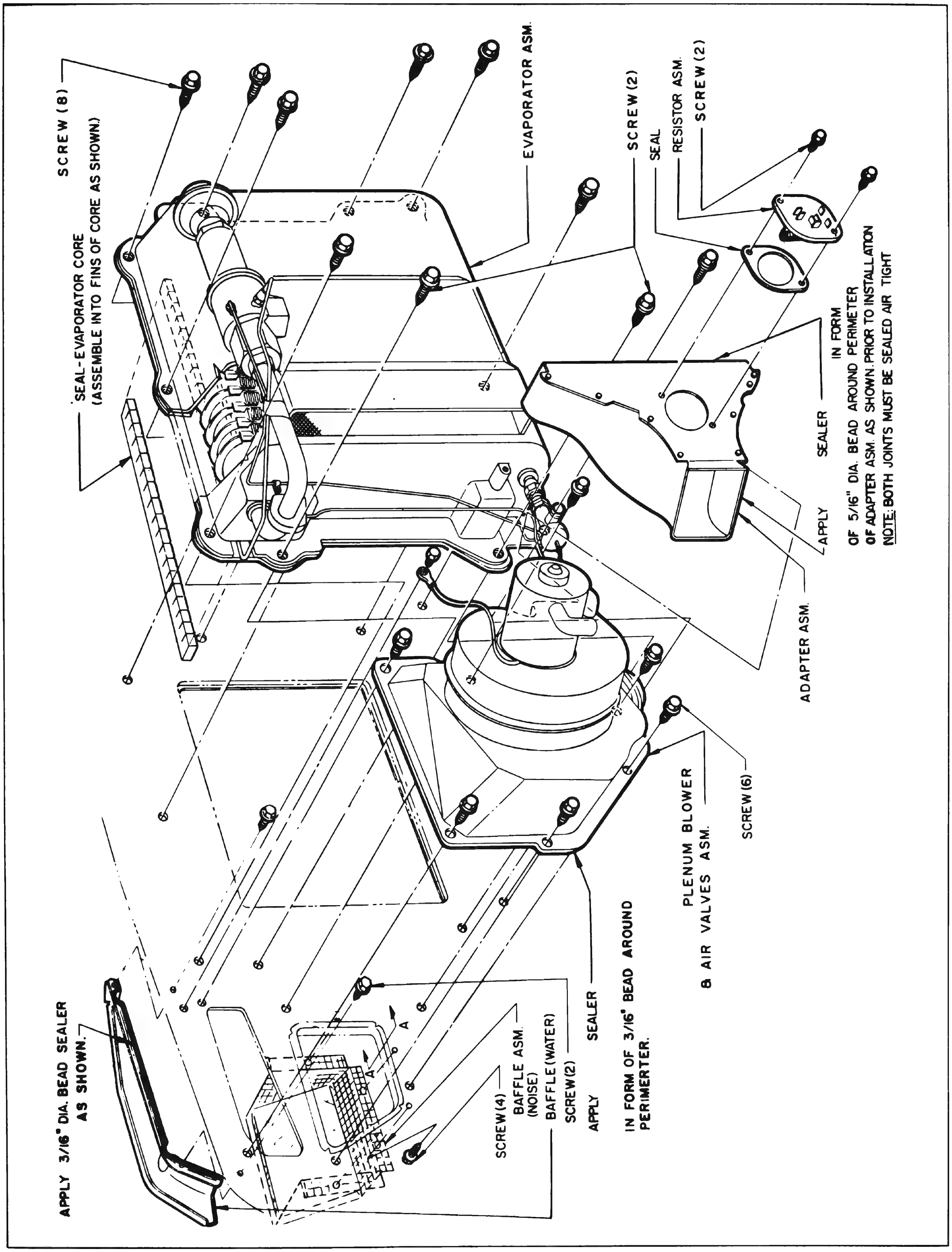


Figure 11-94—Evaporator Assembly, and Plenum Blower and Air Valve Assembly - 4400, 4600 and 4800 Series

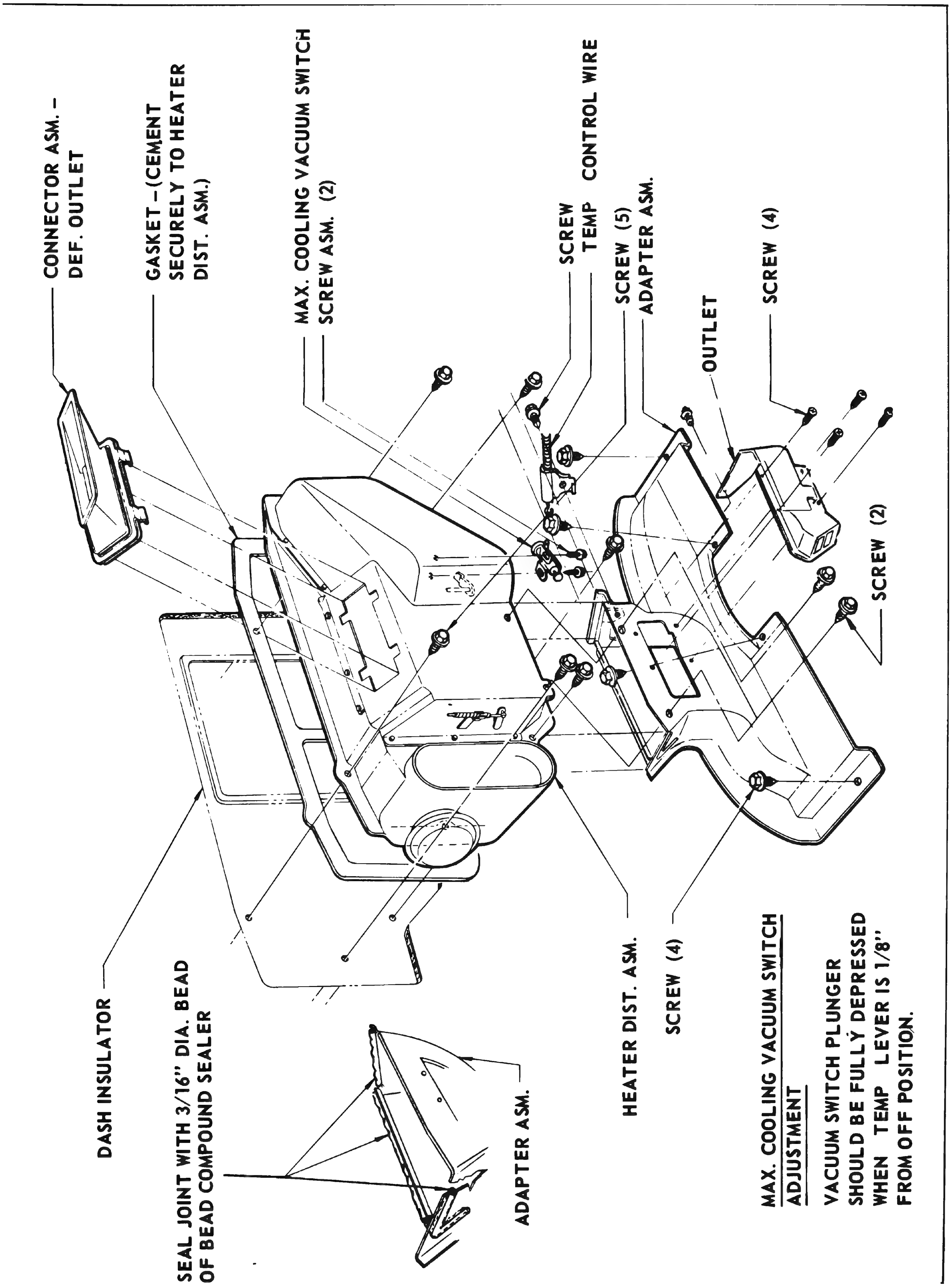


Figure 11-95—Heater Distributor Assembly, Adapter Assembly and Maximum Cooling Vacuum Switch Installation - 4400, 4600 and 4800 Series

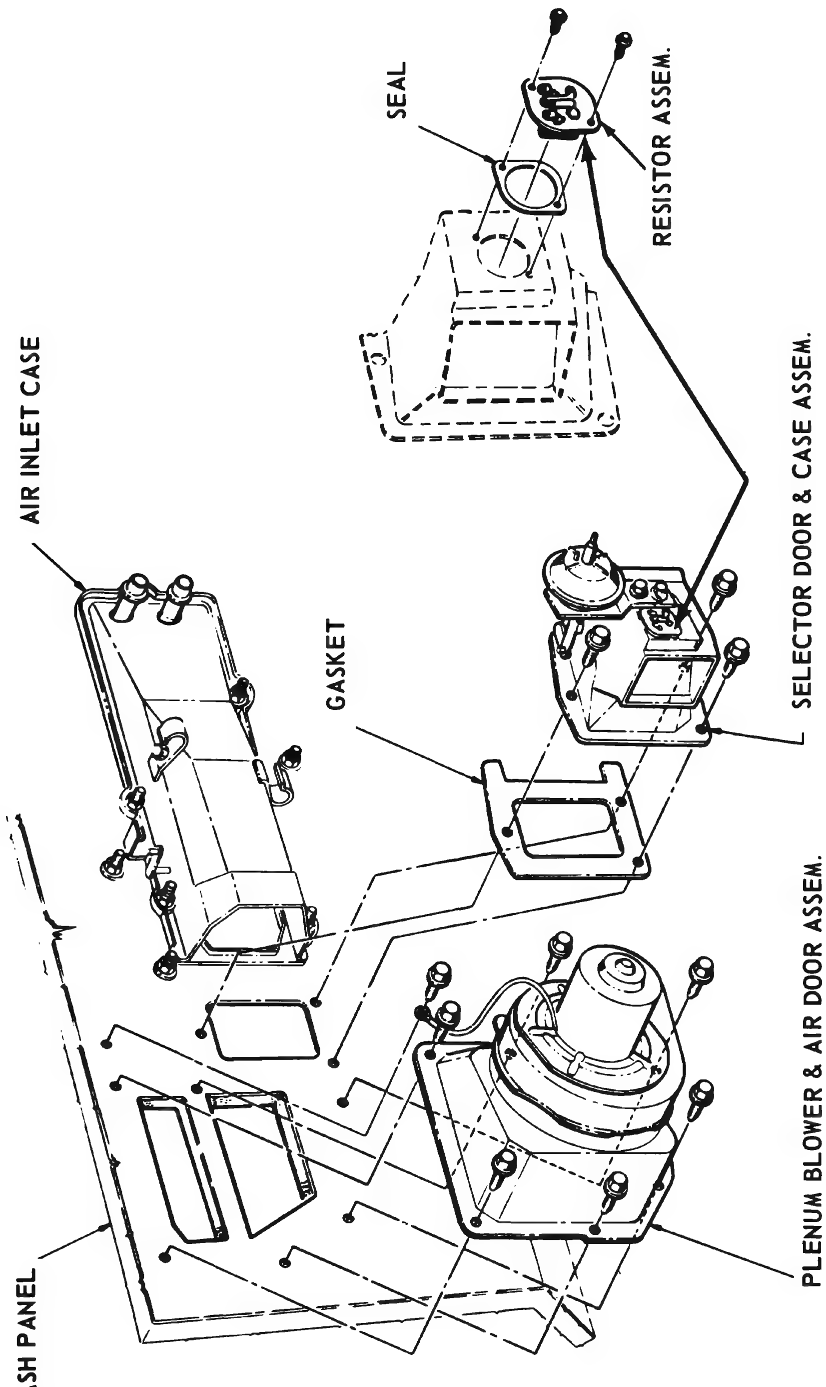


Figure 11-96—Plenum Blower and Air Door Assembly, and Selector Door and Case Assembly Installation - 4700 Series

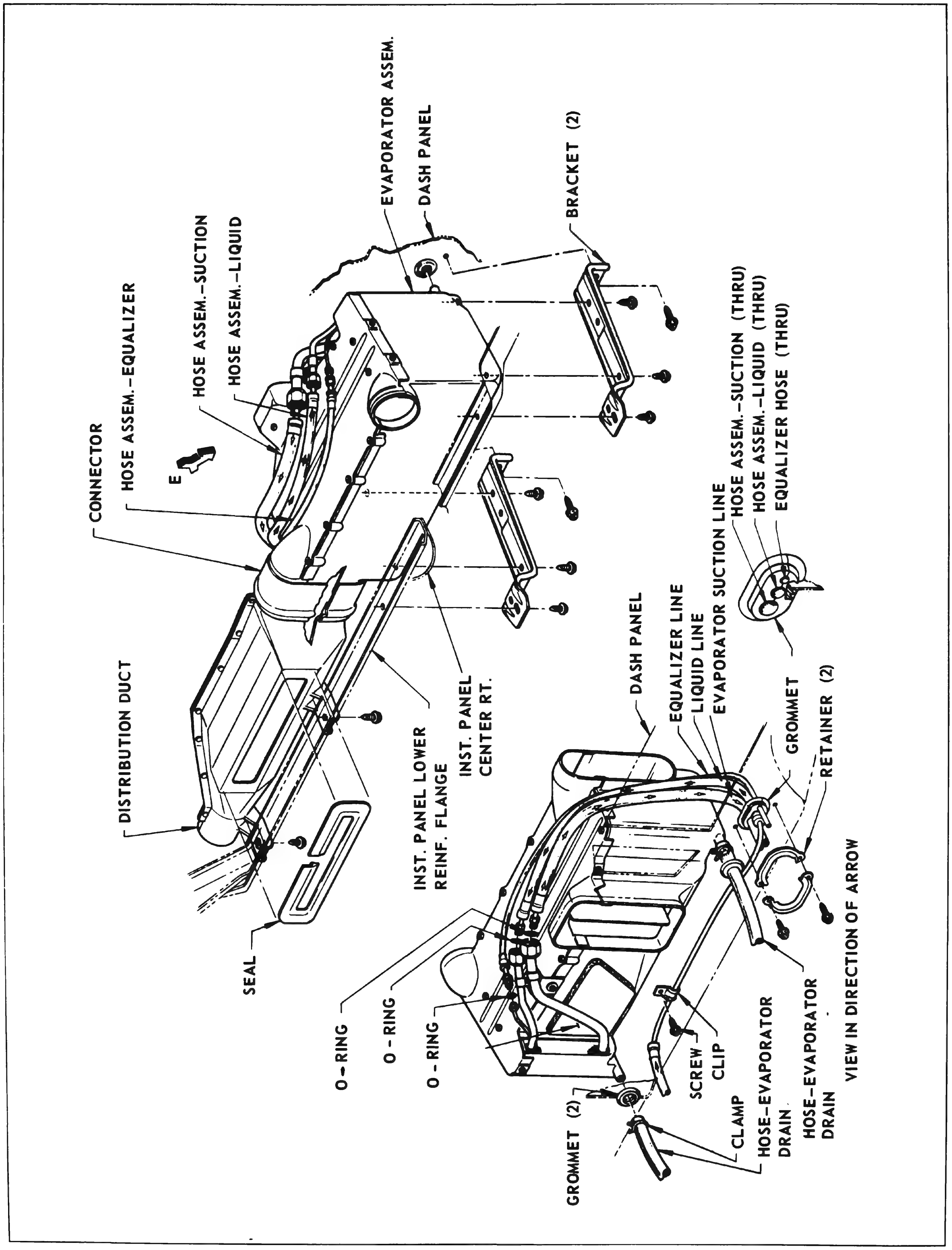


Figure 11-97—Evaporator and Distributor Duct Installation - 4700 Series

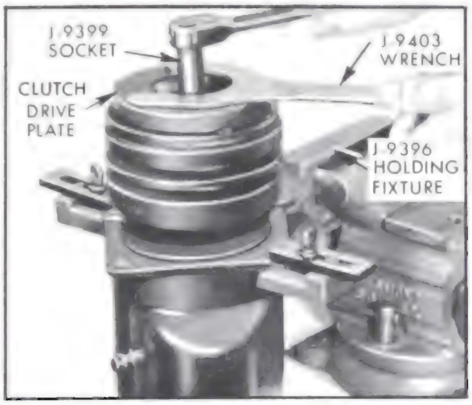


Figure 11-98—Removing Shaft Nut

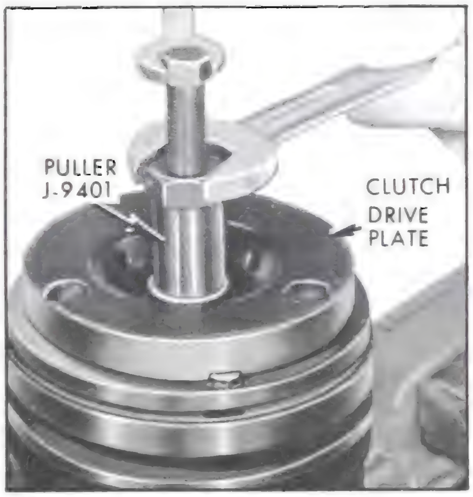


Figure 11-99—Removing Clutch Drive Plate

c. Pulley Assembly and Bearing Removal

1. Remove clutch drive plate. Subparagraph "a".

2. Remove pulley assembly retainer ring, using J-6435, No. 26 Truarc Pliers. See Figure 11-104.

3. Place J-9395 Puller Pilot over compressor shaft and remove pulley assembly, using J-8433 Puller. See Figure 11-105.

IMPORTANT: Puller Pilot J-9395 must be used, or force will cause shaft to move in swash plate, resulting in damage to the cylinder mechanism.

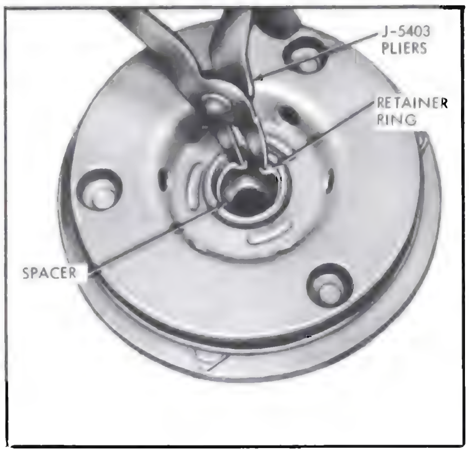


Figure 11-100—Removing Clutch Drive Plate Retainer Ring

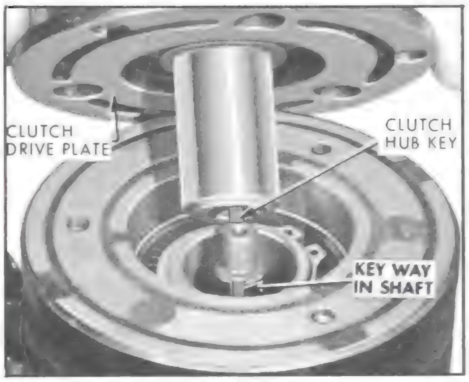


Figure 11-101—Positioning Clutch Drive Plate on Shaft

NOTE: Do not remove pulley bearing unless it is going to be replaced.

4. Remove bearing to pulley retainer wire with a small screwdriver. See Figure 11-106.

5. Remove bearing, using punch or a suitable socket.

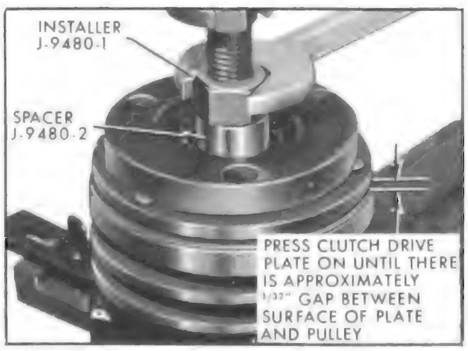


Figure 11-102—Installing Clutch Drive Plate

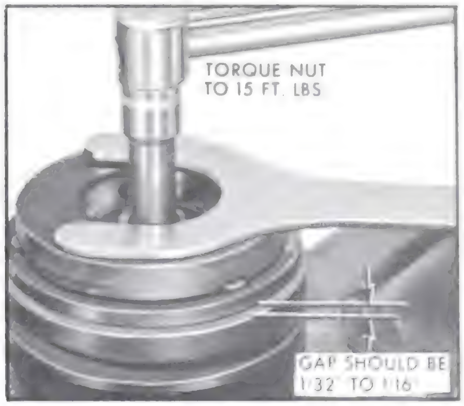


Figure 11-103—Torquing Shaft Nut

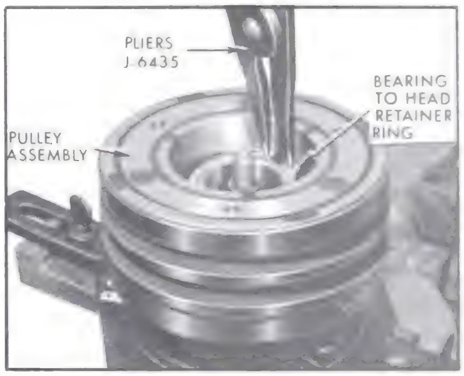


Figure 11-104—Removing or Installing Bearing to Head Retainer Ring

d. Pulley Assembly and Bearing Installation

If the existing pulley assembly and clutch drive plate are to be reused, clean the friction faces on each part with trichlorethylene, alcohol or similar solvent. If

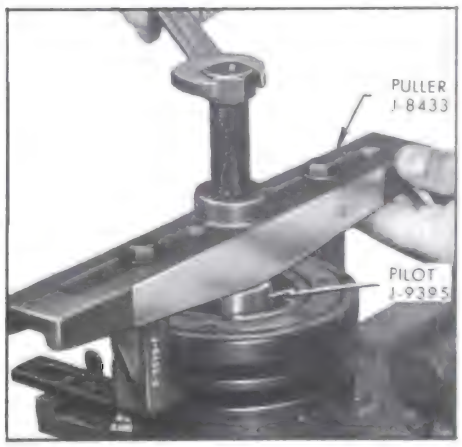


Figure 11-105—Removing Pulley Assembly

Figure 11-106—Removing Bearing to Pulley Retainer Wire

these parts show evidence of warpage, due to overheating, they should be replaced.

1. When replacing a new pulley bearing into the pulley assembly use J-9481 Pulley Bearing Installer and Drive Handle J-8092 as shown. See Figure 11-107.

2. Replace the bearing to pulley retainer wire in pulley, being sure it is properly seated in groove.

3. Support bottom of compressor and install the pulley assembly on the neck of the compressor, using J-9481 installed on J-8092

Figure 11-107—Installing Pulley Bearing

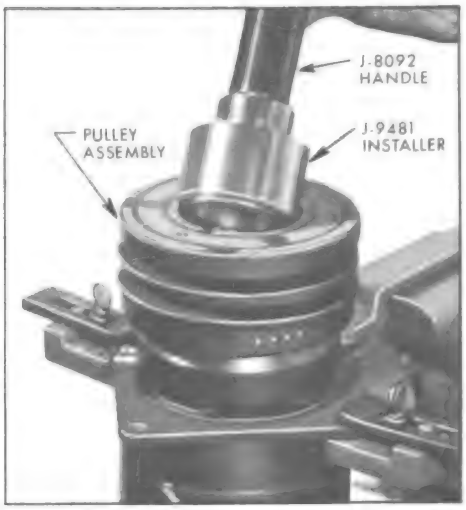


Figure 11-108—Installing Pulley Assembly

as shown. See Figure 11-108. Pulley should rotate freely.

4. Install bearing to head retainer ring with flat side of retainer toward bearing, using J-6435, No. 26 Truarc Pliers.

5. Install clutch drive plate assembly. Subparagraph "b".

e. Coil and Housing Assembly Removal

1. Remove clutch drive plate. Subparagraph "a".

2. Remove pulley assembly and bearing. Subparagraph "c".

3. Note position of electrical terminals and scribe location of coil and housing assembly terminals on compressor body to insure correct location of terminals when coil is reinstalled.

4. Use J-6435, No. 26 Truarc Pliers and remove coil and housing retainer ring, then remove coil and housing assembly. See Figure 11-109.

f. Coil and Housing Assembly Installation

1. Position coil and housing assembly on compressor front head so electrical terminals are in

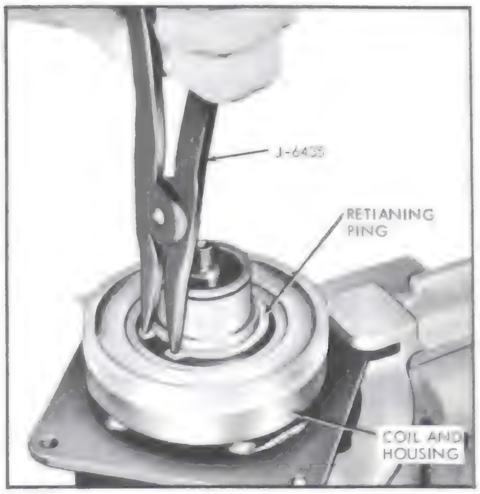


Figure 11-109—Removing or Installing Coil and Housing Retainer Ring

their original location as previously scribed on compressor body. Make certain coil and housing are properly seated in dowels.

2. Replace the coil and housing retainer ring with flat side of ring facing coil, using J-6435, No. 26 Truarc Pliers.

3. Install pulley assembly and bearing. Subparagraph "d".

4. Install clutch drive plate. Subparagraph "b".

g. Shaft Seal Removal

1. Remove clutch drive plate. Subparagraph "a".

2. Remove seal seat retaining ring from inside front head, using

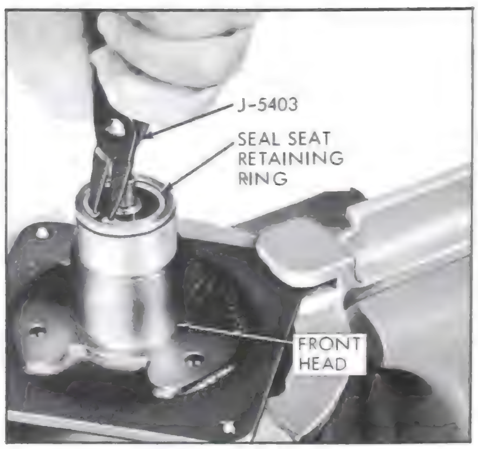


Figure 11-110—Removing or Installing Seal Seat Retainer Ring

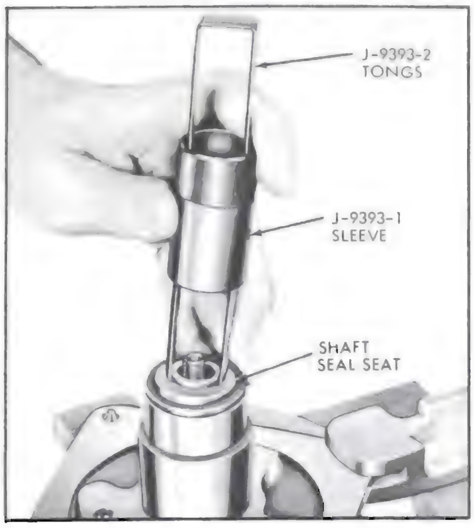


Figure 11-111—Removing or Installing Shaft Seal Seat

J-5403, No. 21 Truarc Pliers. See Figure 11-110.

3. Remove shaft seal seat, using J-9393-1 and 2 to grasp flange on seal seat. See Figure 11-111. Pull straight out on end of tool to remove.

4. Engage tabs on shaft seal assembly with locking tangs on J-9392 Seal Installer and Remover. Press down on tool and twist clockwise to engage. Remove shaft seal by pulling straight out. See Figure 11-112.

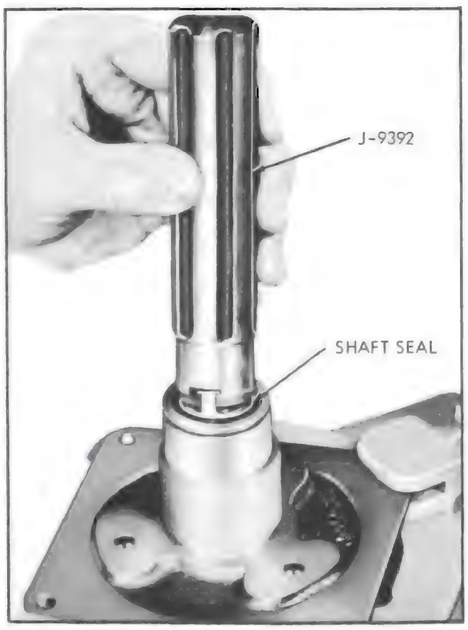


Figure 11-112—Removing or Installing Shaft Seal

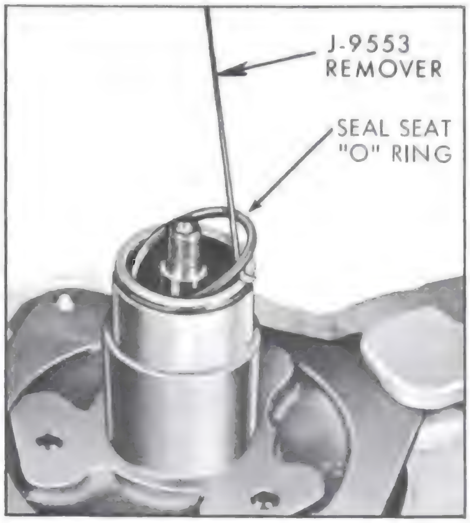


Figure 11-113—Removing Seal Seat O-Ring

5. Remove seal seat "O" ring from interior of hub of front head using J-9553 Remover. See Figure 11-113.

h. Shaft Seal Installation

NOTE: Apply 525 compressor oil to seal parts during assembly.

1. Place shaft seal on J-9392 Installer and insert shaft seal inside front head. Be sure seal is

Figure 11-114—Installing Seal Seat O-Ring

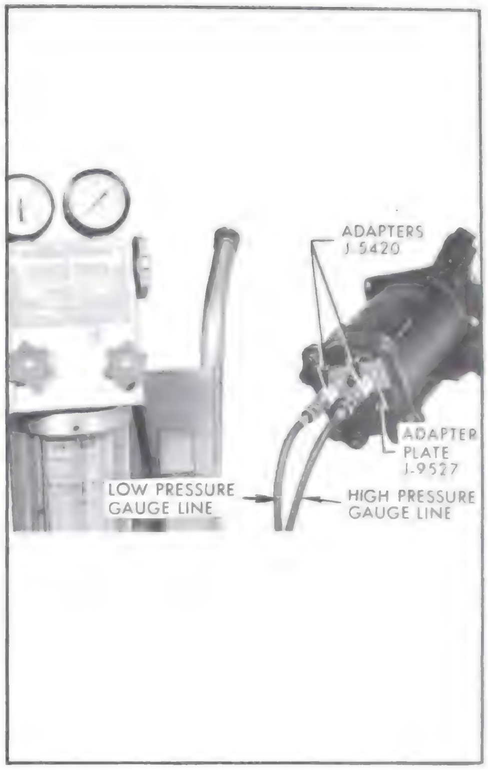


Figure 11-115—Charging Compressor to Check for Leaks

properly seated on shaft. The shaft has two flats provided for the shaft seal.

2. Install a new seal seat "O" ring in its groove inside front head using Installer J-21508. Be sure it is not in seal seat retaining ring groove. See Figures 11-70 and 11-114.

3. Position shaft seal seat on shaft and use Sleeve J-9393-1 to push seal seat down inside front head.

4. Install seal seat retainer ring with flat side of ring going inward using J-5403, No. 21 Truarc Pliers. If necessary, position Sleeve J-9393-1 on retaining ring, and push down on it to engage ring in its groove.

5. Attach charging line Adapter Plate J-9527 on rear of compressor and pressurize suction side of compressor with Refrigerant-12 at pressure corresponding to room temperature. Rotate compressor shaft several times. See Figure 11-115. Leak test with

leak detector and correct any leaks.

6. Install clutch drive plate. Subparagraph "b".

11-17 DISASSEMBLY, INSPECTION AND ASSEMBLY OF COMPRESSOR INTERNAL PARTS

IMPORTANT: A clean work bench, orderliness of the work and a place for all parts being removed and replaced are of great importance. Any attempt to use makeshift or inadequate tools may result in damage and/or improper operation of the compressor.

a. Rear Head and Oil Pump Removal,

CAUTION: Under NO circumstances should compressor be placed on the pulley end.

1. Seal compressor fitting openings and openings in compressor rear head.

2. Thoroughly clean exterior of compressor assembly and blow dry with compressed air.

3. Place compressor assembly on clean, dry work bench.

NOTE: If compressor is not going to be disassembled any further than rear head or oil pump, omit Steps 4, 5, 6, 7 and 8.

4. Remove compressor oil drain plug, tilt compressor and drain oil into clean dry container. It may be possible to get only 4 to 6 ozs. of oil from the compressor.

5. Remove clutch drive plate. Paragraph 11-16, subparagraph "a".

6. Remove pulley assembly. Paragraph 11-16, subparagraph "a".

7. Remove coil and housing assembly. Paragraph 11-16, subparagraph "e".

8. Remove shaft seal. Paragraph 11-16, subparagraph "g".

9. Attach J-9396 Holding Fixture to compressor and firmly mount assembly in vise. See Figure 11-116.

10. Remove pressure relief valve and washer if head is going to be replaced.

11. Remove four lock nuts from threaded studs welded to compressor shell, and remove rear head by tapping lightly with mallet.

12. Examine teflon surface on the rear head casting webs. If any damage is observed, the head should be replaced. See Figure 11-117.

13. Remove suction screen and examine for damage or contamination. Clean or replace as necessary.

14. Mark rear side of both oil pump inner and outer rotors with a pencil so that they can be reinstalled in same position. Remove rotors and inspect for damage. Replace both rotors if one or both show damage.

15. Remove and discard rear shell to head "o" ring.

16. Carefully remove rear discharge valve plate by prying up on assembly as shown with screwdrivers and examine discharge valve reeds and seats. See Figure 11-118. Replace entire assembly if excessively scored or if any one of the three reeds are broken, or seats are damaged.

17. If rear suction valve reed disc did not come out with valve plate, carefully remove reed as shown with two small screwdrivers. See Figure 11-119. Replace valve disc if damaged.

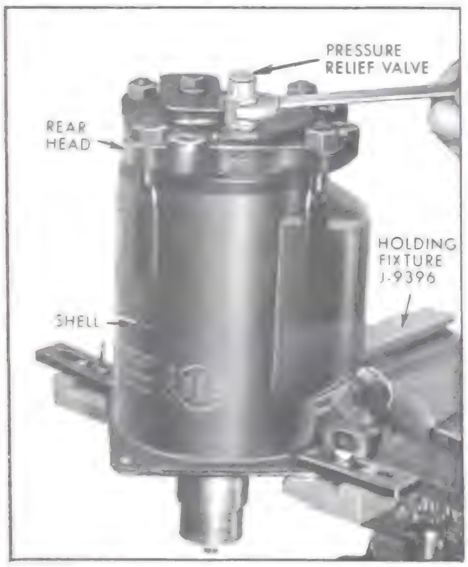


Figure 11-116—Removing or Installing Pressure Relief Valve

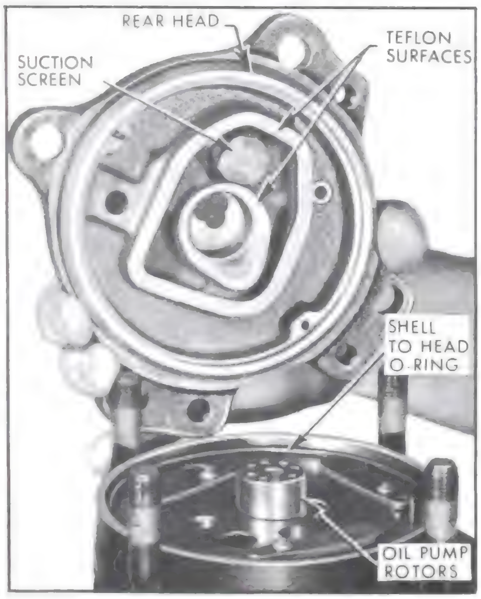


Figure 11-117—Rear Head

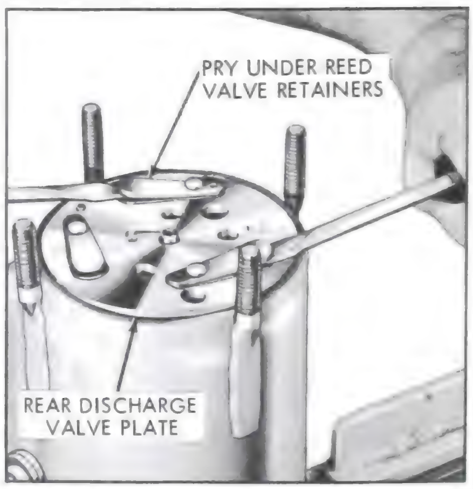


Figure 11-118—Removing Rear Discharge Valve Plate

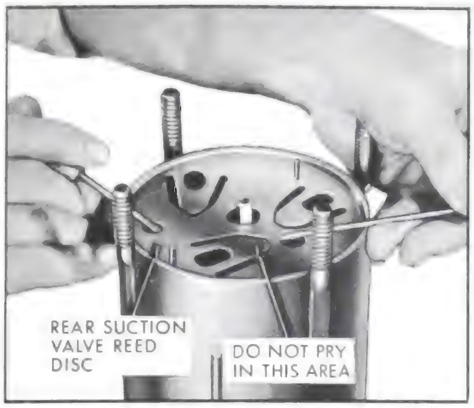


Figure 11-119—Removing Rear Suction Valve Reed Disc

NOTE: See subparagraph "g" for installation of rear head and oil pump.

b. Compressor Cylinder Assembly and Front Head Removal

1. Remove oil inlet tube, using J-6586 Remover. See Figure 11-120. If tube "O" ring did not come out with tube, remove it from cylinder with small wire.

2. Push on front of compressor shaft to remove cylinder assembly from shell. See Figure 11-121. The cylinder assembly will slide out of shell when shell is inverted.

CAUTION: Do not hammer or use force on end of shaft.

3. If the front discharge valve plate and suction valve reed disc were removed with cylinder assembly, remove these parts from shaft before proceeding and examine for damage.

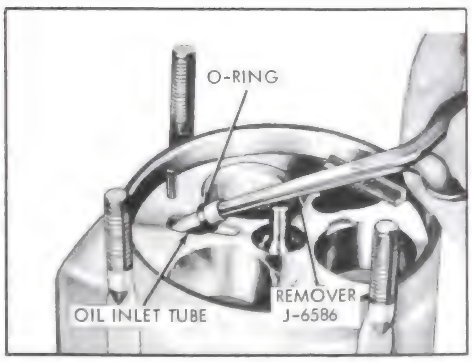


Figure 11-120—Removing Oil Inlet Tube

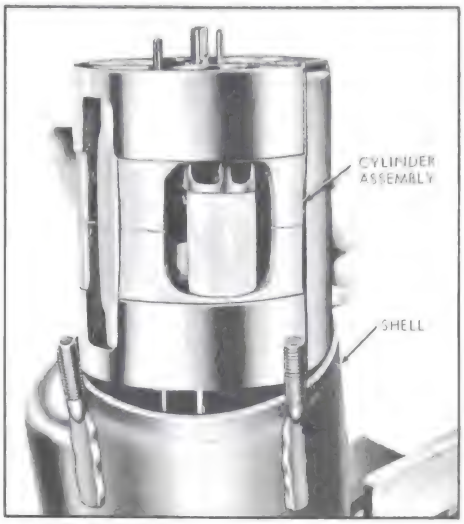


Figure 11-121—Removing Cylinder Assembly

4. Examine cylinder assembly for any obvious damage.

NOTE: If cylinder assembly has sustained major damage, due possibly to loss of refrigerant and/or oil, it may be necessary to replace unit with a service cylinder and shaft assembly rather than replace individual parts.

5. Remove compressor front head, using rubber mallet or wood block to unseat head from shell. See Figure 11-122. Care must be used to protect teflon surface on head from being damaged.

6. Remove and discard front head to shell "O" ring seal.

Figure 11-122—Removing Front Head

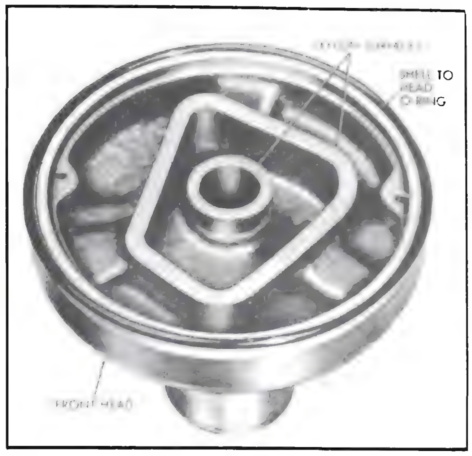


Figure 11-123—Front Head

7. Examine teflon sealing surface on front head for damage and/or deep scratches. Replace if necessary. See Figure 11-123.

NOTE: If compressor cylinder assembly is going to be replaced, omit subparagraphs "c", "d" and "e".

c. Disassembly of Compressor Cylinder Assembly

1. Remove suction pass cover as shown in Figure 11-124 and discard seal on cover.

2. Place cylinder assembly in fixture as shown.

3. Number pistons "1", "2" and "3" and their cylinder bores so parts can be replaced in their original locations.

Figure 11-124—Removing Suction Pass Cover and Seal

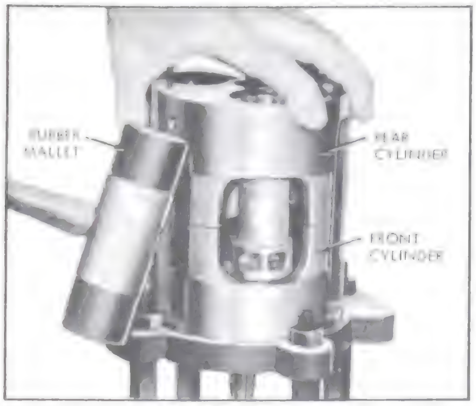


Figure 11-125—Separating Cylinder Halves

4. Obtain clean J-9402 assembly parts tray to retain compressor parts during disassembly.

5. Separate front and rear cylinder halves, using a wood block or rubber mallet. See Figure 11-125. Rotate swash plate so that discharge tube does not contact it. A 9/16" open end wrench may be used on the shaft seal area of shaft to rotate swash plate.

6. Remove rear cylinder half from pistons.

7. Rotate shaft until a piston is at its highest point. Push up on shaft and remove one piston assembly at a time. See Figure 11-126. Place parts in parts tray to keep them separated. See Figure 11-127.

8. Remove piston rings, balls and shoe discs. Discard the shoe discs. Examine piston balls, if satisfactory for reuse, place in parts tray with proper end of

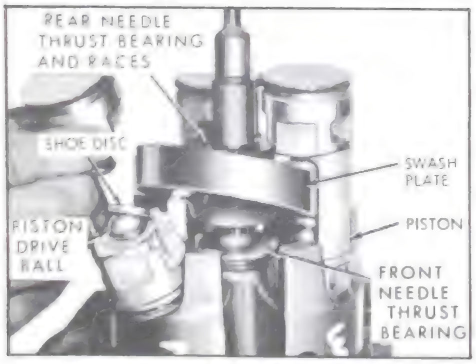


Figure 11-126—Removing Piston Assembly

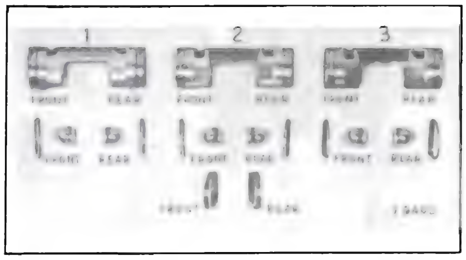


Figure 11-127—Parts Tray J-9402

piston. The front end of piston has identifying notch in casting web. See Figure 11-128.

9. Remove rear needle thrust bearing and races. Discard all three pieces.

10. Push on shaft to remove shaft and swash plate assembly front cylinder half.

11. Remove front needle thrust bearing and races. Discard all three pieces.

12. Remove discharge tube from cylinder half by twisting it out with suitable pliers or by holding on to it with pliers and tapping on pliers.

13. Examine swash plate surfaces for excessive scoring or damage. If satisfactory, reuse. If necessary, replace mainshaft and swash plate assembly.

14. Wash compressor internal parts in a tank of clean trichloroethylene, alcohol or similar solvent. <u>Blow dry all parts, using a source of clean, dry air</u>. If drive balls show any signs of damage, replace.

15. Examine the front and rear cylinder halves and replace if

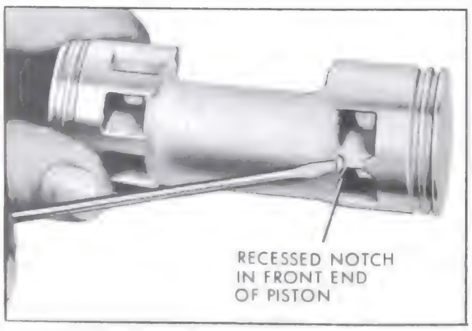


Figure 11-128—Piston Assembly

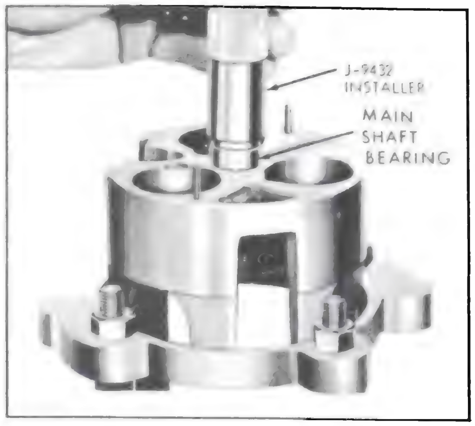


Figure 11-129—Installing Main Shaft Bearing

cylinder bores are deeply scored or damaged.

16. Examine the mainshaft bearings. There is one in each cylinder half. If a bearing is damaged, remove bearing with a suitable socket or punch. Install new bearing with J-9432 so that lettering on bearing is toward outside of cylinder half. See Figure 11-129.

d. Adjusting Compressor Shaft End Play and Piston Shoe Disc Clearance

IMPORTANT: <u>The following operations are required when it is practical to replace an internal part or parts of the cylinder assembly. If the complete cylinder assembly is replaced, gauging of the shaft end play and shoe disc clearance is not required.</u>

1. Secure four zero thrust races, three zero shoe discs and two new thrust bearings.

2. Apply clean petroleum jelly to a zero thrust race, a new needle thrust bearing and a second zero thrust race. Assemble this "sandwich" of parts to front end of compressor mainshaft.

3. Place FRONT half of cylinder on J-9397 Fixture. Insert threaded end of shaft (with front thrust bearing assembly) through front cylinder half and allow thrust race assembly to rest on

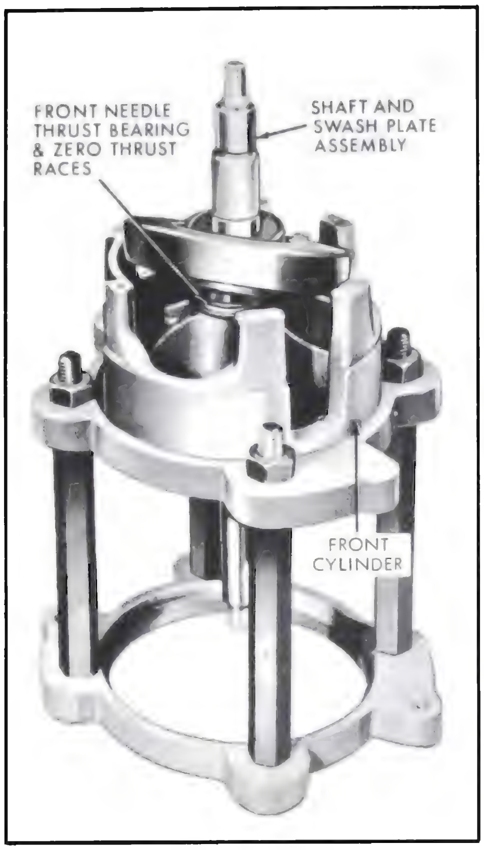


Figure 11-130—Shaft Assembly and Front Needle Thrust Bearing and Races in Front Cylinder Half

hub of cylinder. See Figure 11-130.

4. Place a zero thrust race, a new thrust bearing and a second zero thrust washer on REAR of compressor mainshaft so it rests on hub of swash plate.

5. Lightly apply clean petroleum jelly to ball pockets of each of three pistons.

6. Place balls in piston pockets.

7. Lightly apply clean petroleum jelly to cavity of three new zero shoe discs.

8. Place a zero shoe over each ball in FRONT end of piston. Do not place shoes on piston rear balls.

NOTE: Do not assemble any piston rings on pistons at this time.

9. Rotate shaft and swash plate until high point of swash plate is over piston cylinder bore, which

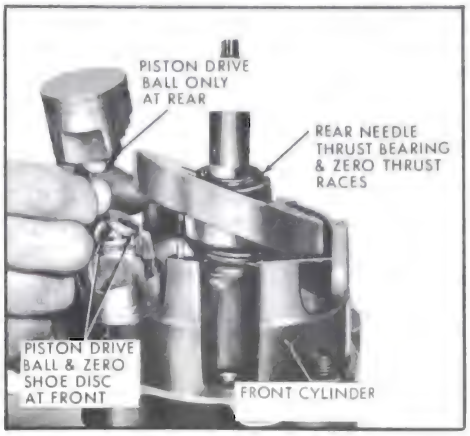


Figure 11-131—Installing Piston Assembly in Cylinder for Gauging

has been identified as No. 1. Insert front end of No. 1 piston (notched end) in cylinder bore (toward the front of compressor) and at same time, place front ball and shoe and rear ball only over swash plate.

IMPORTANT: It is necessary to lift shaft assembly when installing pistons. Hold front thrust bearing pack tightly against swash plate hub while lifting shaft.

10. Repeat this operation for No. 2 and No. 3 pistons. Balls and shoes must adhere to piston during this assembly.

11. Align rear cylinder half casting with bores, suction passage, discharge holes, dowel pins, etc. Tap into place, using a wood block and mallet. See Figure 11-132.

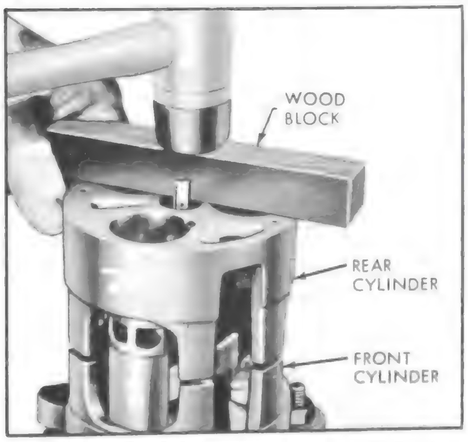


Figure 11-132—Assembling Rear Cylinder Half

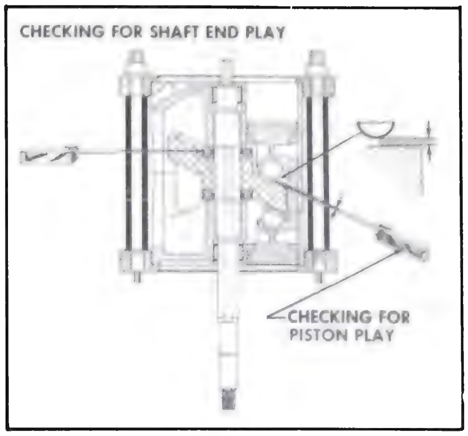


Figure 11-133—Checking Cylinder Clearances

12. Place cylinder assembly in J-9397 Compressing Fixture with front of compressor shaft pointing up, positioning discharge tube opening between fixture bolts. This will permit access for the feeler gauge. Assemble fixture head ring and nuts to the cage, tighten nuts evenly to 15 lb. ft. torque.

13. Use a leaf-type feeler gauge to check clearance between REAR ball and swash plate for each piston.

(a) Use a suitable combination of feeler gauge leafs until the combination will result in a satisfactory "feel" between ball and swash plate. See Figures 11-133 and 134.

(b) After a suitable combination of feeler gauge leaves have been

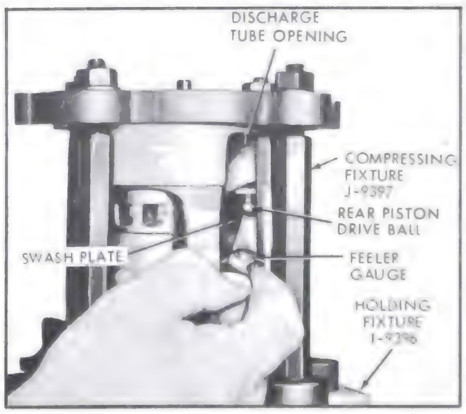


Figure 11-134—Gauging Clearance Between Rear Drive Ball and Swashplate

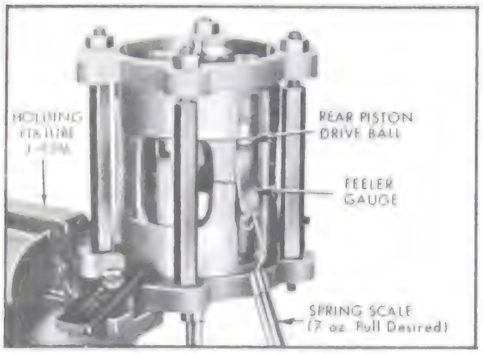


Figure 11-135—Checking Selected Feeler Gauge with Spring Scale

selected for a satisfactory "feel" between the rear ball and swash plate as instructed in Step (a), attach a spring scale to end of feeler leaf. Spring scale must be calibrated in ounces, such as Generator brush tension scale J-5164 or spring scale used for checking distributor point spring tension. Insert the selected feeler leaf between rear ball and swash plate, then pull straight out on spring scale with a steady, even pull being sure feeler does not bend or kink. See Figure 11-135. Record reading on scale. Spring scale must be read while feeler is moving. If selected feeler is correct size, spring scale will read between 4 and 8 ounces (the higher reading is desired). If reading is not within limits, select the next .0005" smaller or larger feeler leaf and repeat spring scale check until proper reading is obtained. Then proceed with Steps (c), (d), (e), (f), and (g) checking selected feeler leaf drag with spring scale at each location. The cylinder parts and feeler leaves must be very clean and coated with 525 viscosity compressor oil.

NOTE: By using the spring scale to check the selected feeler leafs, a standard may be set up as to the amount of feeler leaf drag required to properly rebuild the compressor. Also, the size of the numbered shoe discs and thrust bearing races for service has been determined by using the spring scale method of checking feeler leaf drag.

(c) Rotate the shaft approximately 120° and make a second check with feeler gauge between same ball and plate.

(d) Rotate shaft again approximately 120 and repeat check with feeler gauge between these same parts.

(e) From this total of three checks between the same ball and swash plate at 120 increments on swash plate, use the minimum feeler gauge reading to select a numbered shoe to correspond to this reading. See Example below.

Example:

	Position 1	Position 2	Position 3
Piston #1	.019	.020	.019
Select and use a No. 19 Shoe			
Piston #2	.020	.020	.020
Select and use a No. 20 Shoe			
Piston #3	.021	.020	.021
Select and use a No. 20 Shoe			

SHOE DISC CHART

Service Part Number	Identification No. Stamped on Shoe Disc
6557000	0
6556175	17-1/2
6556180	18
6556185	18-1/2
6556190	19
6556195	19-1/2
6556200	20
6556205	20-1/2
6556210	21
6556215	21-1/2
6556220	22

(f) Mark piston number "1," "2" or "3" on selected shoe package and place in corresponding position in parts tray.

(g) Repeat the above procedure on the other two pistons.

14. The next gauging operation is to determine space between REAR thrust bearing and rear outer thrust race.

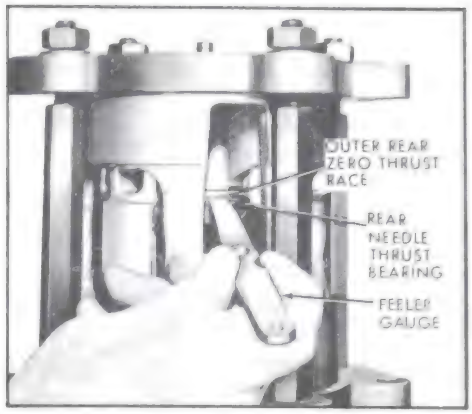


Figure 11-136—Gauging Clearance Between Rear Needle Thrust Bearing Rear Outer Race

(a) Use a suitable combination of feeler gauge leaves to get a satisfactory "feel" between these two parts. See Figure 11-136.

(b) The spring scale method should also be used to check the drag of the feeler leaf that has been selected for clearance between rear thrust bearing and rear outer race. See Figure 11-137. The reading on the spring scale when pulling feeler leaf between these parts also should be between 4 and 8 ounces (the higher reading is desired). If reading is not within limits, select the next smaller or larger feeler leaf and repeat spring scale drag check until proper reading is obtained.

(c) Select from stock a numbered thrust race that corresponds to

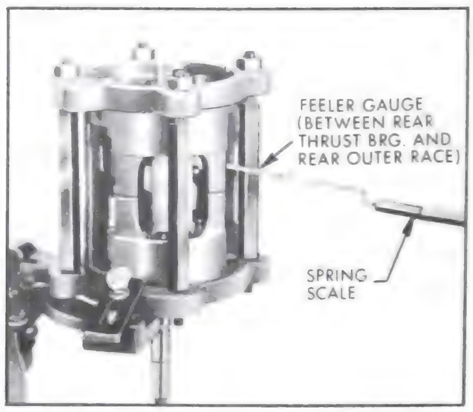


Figure 11-137—Checking Selected Feeler Gauge with Spring Scale

feeler gauge reading. For example, if feeler gauge reading is .009", a race with a number "9" stamped on it should be selected and be installed in place of the rear outer race.

THRUST BEARING RACE CHART	
Service Part Number	Identification No. Stamped on Race
6556000	0
6556060	6
6556065	6-1/2
6556070	7
6556075	7-1/2
6556080	8
6556085	8-1/2
6556090	9
6556095	9-1/2
6556100	10
6556105	10-1/2
6556110	11
6556115	11-1/2
6556120	12

(d) Mark the selected REAR thrust race and place it in the J-9402 assembly parts tray corresponding to its position.

15. Remove cylinder assembly from J-9397 compressing fixture.

16. Separate cylinder halves. It may be necessary to use a fiber block and mallet.

17. Remove rear half cylinder.

18. Carefully remove one piston at a time from swash plate and front half cylinder. Do not lose relationship or position of front ball and shoe, and rear ball. Transfer each piston, balls and shoe assembly to their proper place in the J-9402 assembly tray.

19. Remove REAR outer zero thrust race from shaft and replace it with selected numbered thrust race, determined in Step No. 14. Apply a light coat of petroleum jelly to thrust races to aid in holding them in place during assembly.

NOTE: This zero thrust race may be put aside for re-use in additional gauging and/or rebuild operations.

e. Assembly of Compressor Cylinder Assembly

Be sure to install all new seals and "O" rings and to lubricate all the parts generously with 525 compressor oil during assembly.

1. Assemble a piston ring, scraper groove toward the outside of piston, to each end of the three pistons.

2. Apply a light coat of petroleum jelly to selected numbered shoes and place them over correct ball in rear of piston.

3. With front and rear thrust bearing assemblies on shaft and shaft installed in front cylinder half, rotate swash plate so high point is above cylinder bore No. 1. Carefully assemble No. 1 piston (complete with ball and zero shoe on FRONT end, and ball and numbered shoe on REAR end) over swash plate. See Figure 11-138. Position piston rings so that the gap is toward center of cylinder. Compress and enter piston ring into front half cylinder. Repeat this operation for pistons No. 2 and No. 3. See Figure 11-139.

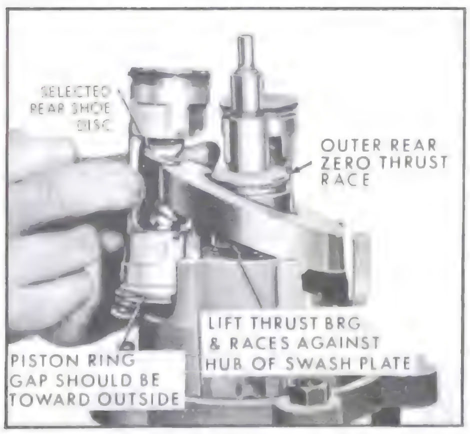


Figure 11-138—Installing Piston in Cylinder Assembly

Figure 11-139—Compressing Front Piston Ring

4. Assemble one end of service discharge tube into hole in front cylinder. See Figure 11-140.

5. Rotate shaft to position pistons in a "stair step" arrangement. See Figure 11-141. Position piston ring gaps toward outside of cylinder. Place rear half cylinder over shaft and start pistons into cylinder bores.

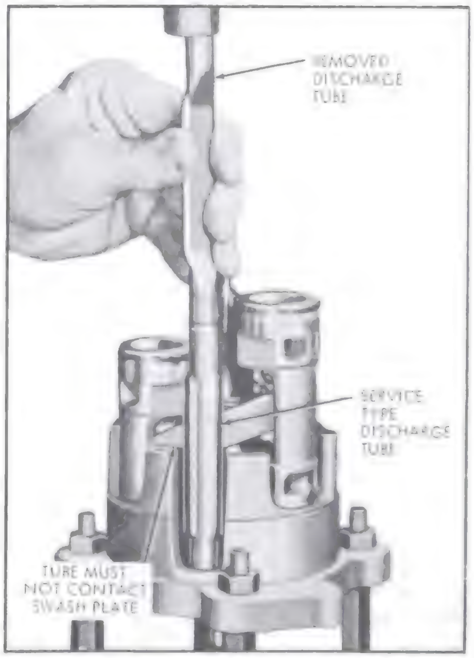


Figure 11-140—Installing Service Type Discharge Tube

Figure 11-141—Pistons Positioned in "Stair Step" Arrangement

(a) Compress piston ring on each piston so as to permit its entrance into cylinder. See Figure 11-142. If ring is not properly compressed when installing rear cylinder half, ring will be broken.

(b) When all three pistons and rings are in their respective cylinders, align end of the discharge tube with hole in rear half cylinder, making sure flattened portion of this tube faces inside of compressor for swash plate clearance.

(c) When satisfied that all parts are in proper alignment, tap with a fiber block and mallet to "seat" rear cylinder over locating dowel pins.

6. Generously lubricate all moving parts with clean Frigidaire

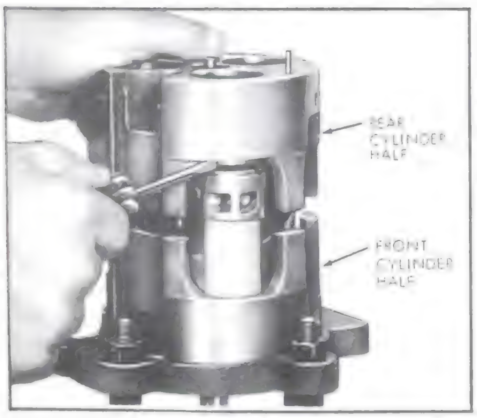


Figure 11-142—Compressing Rear Piston Ring

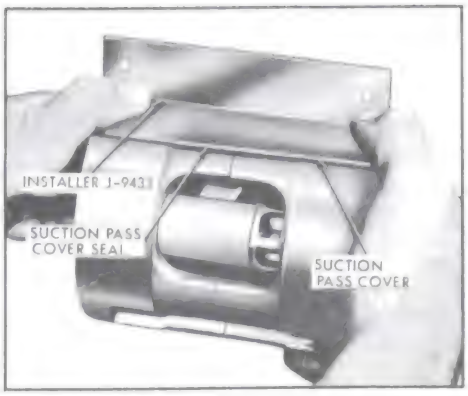


Figure 11-143—Installing Suction Pass Cover and Seal

525 viscosity oil. Check for free rotation of swashplate.

7. Assemble a new rectangular seal to suction pass cover.

(a) Coat seal with clean 525 viscosity oil.

(b) Start one side of seal and cover into "dove tail" slot in the cylinder.

(c) Use J-9433 suction pass cover seal installer as a "shoe horn", by placing it between the seal on opposite side and the "dove tail" slot. See Figure 11-143.

(d) Center cover and seal with ends of cylinder faces.

(e) Press down on cover to snap it into place.

(f) Remove J-9433 installer as shown in Figure 11-144.

(g) Examine cover and seal to be sure cover is properly seated and seal is not damaged.

8. If necessary to replace a locator pin, use suitable pliers to

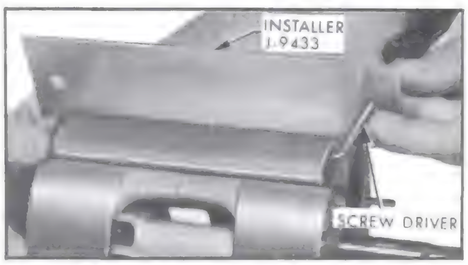


Figure 11-144—Removing Installer J-9433

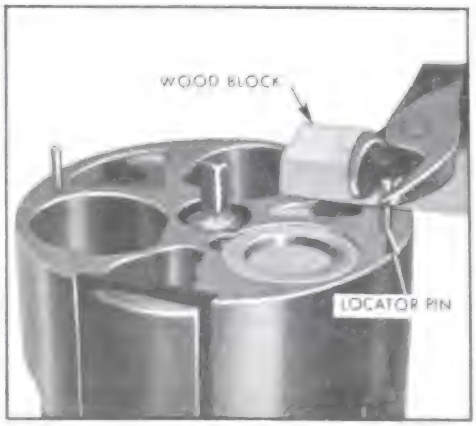


Figure 11-145—Removing Locater Pin

remove pin, using care not to damage surface of cylinder. See Figure 11-145. Install new pin, carefully tapping it into place.

f. Front Head and Cylinder Assembly Installation

1. Install discharge tube front "O" ring and bushing. See Figure 11-146.

2. Assemble front suction valve reed disc to front end of cylinder. Align dowel pin holes, suction ports and oil return slot. See Figure 11-147.

3. Assemble front discharge valve plate, aligning holes with dowel pins and proper openings in head. See Figure 11-148.

Figure 11-146—Installing Discharge Tube "O" Ring and Bushing

Figure 11-147—Front Suction Valve Reed Disc Installed

4. Coat teflon gasket surfaces on webs of compressor front head casting with clean 525 viscosity compressor oil.

5. Examine location of dowel pins and contour of webs and mark dowel location on head with pencil as shown. Use care to avoid damaging teflon surfaces. See Figure 11-148. When in proper alignment, seat on front discharge valve plate with light mallet taps.

6. Place compressor shell with J-9396 holding fixture in vise so rear end of shell is up.

Figure 11-148—Installing Front Head on Cylinder Assembly

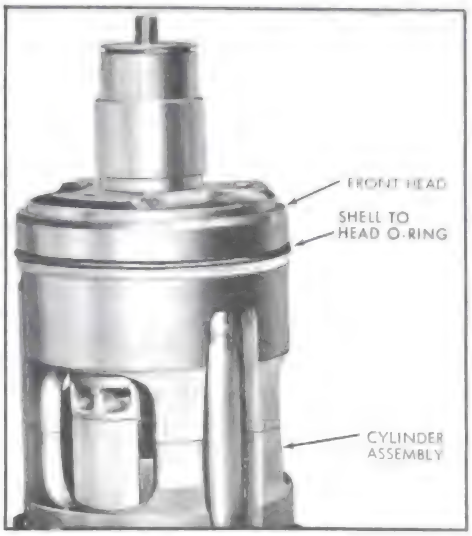


Figure 11-149—Front Head Installed on Cylinder Assembly

7. Install a new shell to head "O" ring on shoulder at rear of front head. See Figure 11-149.

8. Apply 525 viscosity oil on the "O" ring and surfaces of the front head.

9. Coat the inside machined surfaces of shell with clean 525 viscosity compressor oil. Line up oil sump with oil intake tube hole and lower mechanism into shell. Extreme care must be used to prevent large "O" ring seal from being damaged. Maintain this alignment when lowering mechanism into place. See Figure 11-150.

10. Place "O" ring on the oil inlet tube; apply oil to cavity and "O" ring. Insert tube and "O" ring, rotating compressor mechanism as necessary and align tube with hole in the shell baffle. Be sure "O" ring and inlet tube are properly seated.

11. Install discharge "O" ring and bushing.

g. Oil Pump and Rear Head Installation

1. Position rear suction valve reed disc to align with dowel pins, reed tips, and ports in head.

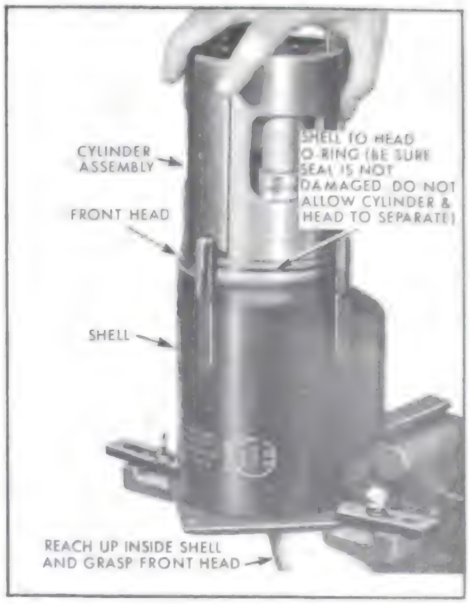


Figure 11-150—Installing Cylinder Assembly into Shell

2. Position rear discharge valve plate to align with dowel pins and ports and slide it into place over locator pins.

3. Assemble the inner oil pump rotor over the "D" shaped flat on the shaft. Place outer oil pump rotor over inner oil pump rotor. If original gears are used, be sure gears are installed in their original positions.

4. Generously oil valve plate around outer edge where large

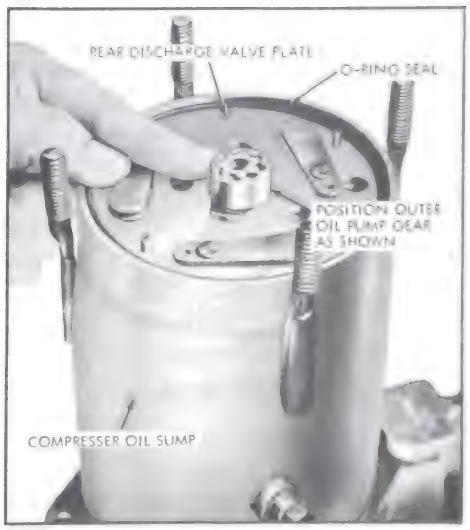


Figure 11-151—Positioning Oil Pump Outer Rotor

Figure 11-152—Installing Rear Head

"O" ring will be placed. Oil valve reeds, oil pump rotors, and area where teflon gasket will contact valve plate.

5. Coat new shell to head "O" ring with oil and place it on rear discharge valve plate in contact with shell.

6. Place suction screen in rear head if removed.

7. Position the oil pump outer rotor as shown in Figure 11-151.

8. Assemble rear head to shell, using care not to damage the teflon sealing surfaces on head.

NOTE: If locator pins do not engage hole in rear head, grasp front head and slightly rotate cylinder assembly. See Figure 11-152.

9. Assemble new nuts to threaded shell studs and tighten to 20 lb. ft. torque.

10. Replace pressure relief valve, if removed, using new copper washer.

11. Place new "O" rings on discharge and suction ports in compressor. Assemble charging line Adapter Plate J-9527 to compressor.

12. Invert compressor and compressor holding fixture in vise.

13. Install shaft seal assembly. Paragraph 11-16, subparagraph "h".

NOTE: When checking compressor for leaks as instructed in seal installation, it is also recommended to check for internal leaks as follows:

With gauge set attached to compressor as shown, pressurize discharge side of compressor only. If the same pressure is immediately noted on the suction side gauge as on the discharge gauge, it indicates an internal leak such as head teflon sealing surface, discharge tube, to shell head "O" ring seal or reed valves. Also observe the reading on the high pressure gauge with shut-off valves closed. If gauge reading drops more than 10 pounds in 30 seconds, it indicates an internal leak in compressor.

14. Depressurize compressor and correct any leaks as necessary.

15. Remove charging line adapter plate from compressor and install end plate.

16. Refer to paragraph 11-15, subparagraph "j" for amount of 525 compressor oil to install in compressor. The oil is installed through oil drain screw opening.

17. Install coil and housing assembly. Paragraph 11-16, subparagraph "f".

18. Install pulley assembly and bearing. Paragraph 11-16, subparagraph "d".

19. Install clutch drive plate. Paragraph 11-16, subparagraph "b".

11-18 EVACUATION, LEAK TESTING AND CHARGING OF AIR CONDITIONER

Tool J-8393 Portable Air Conditioner Service Station is a Kent-Moore unit designed specifically for servicing automobile air conditioners. J-8393 provides a means of measuring refrigerant without the use of scales. The unit also makes it possible to charge a system without heating the refrigerant tank. As complete instructions are printed on the control panel of J-8393 and the instructions differ from those used with conventional equipment, only conventional equipment will be considered in the paragraph.

a. Evaluation and Leak Testing of System

1. Attach gauge lines, adapters and vacuum pump set-up as shown in Figure 11-153 and discharge any refrigerant that may be in system.

2. Start the vacuum pump, open both valves on gauge set, then slowly open the shut-off valve on the vacuum pump.

CAUTION: If valve on the vacuum pump is opened too quickly, oil may be forced out of pump.

3. Operate vacuum pump until at least 28 inches vacuum (at sea level) is registered on the Low pressure gauge, then continue to run pump for at least ten minutes.

NOTE: Allowance should be made for elevation when obtaining a vacuum. A vacuum of 28 inches of mercury at or near sea level is required. For higher levels, the required vacuum may be reduced by 1 inch of mercury for each 1,000 feet of elevation.

4. If a 28 inch vacuum cannot be obtained, close pump shut-off valve and stop pump, then open the refrigerant-12 cylinder valve

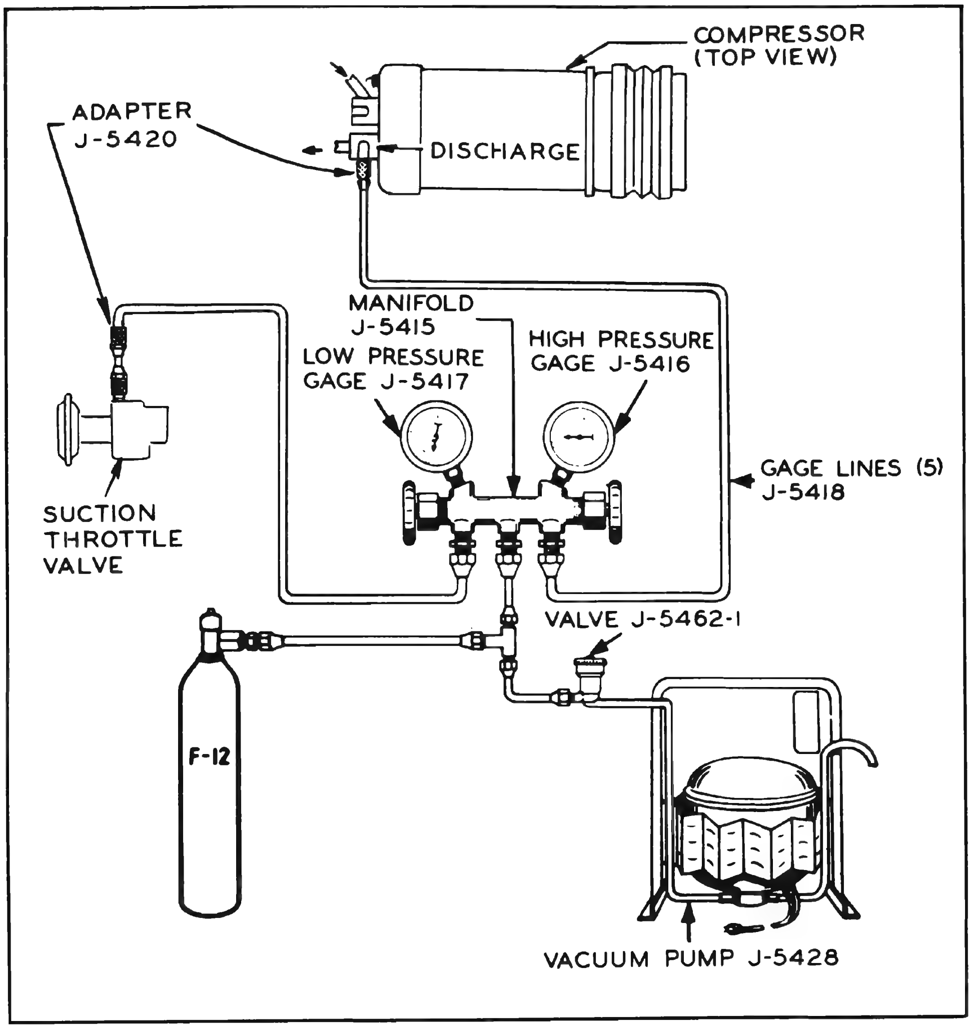


Figure 11-153—Setup for Evacuating, Leak Testing and Charging System

to charge the system at cylinder pressure. After closing the cylinder valve, leak test the complete system including gauge connections and correct any leaks found. Then re-evacuate system.

5. After 28 inches of vacuum has been maintained for ten minutes, close the vacuum pump shut-off valve and stop the pump. Observe gauge and if loss of vacuum is 2 inches or more in 5 minutes, there is a leak in the system and must be corrected.

6. If system checks out, charge the system with refrigerant-12 at cylinder pressure. Then with refrigent-12 cylinder valve closed, again evacuate the system with pump at 28 inches of vacuum for ten minutes. This charging and second evacuation is for the purpose of removing any air or moisture that may have entered the system.

7. After maintaining the 28 inches of vacuum for ten minutes, close the vacuum pump shut-off valve and stop the pump. The refrigerant system is now ready for charging.

b. Charging the System

1. With the vacuum pump, refrigerant-12 cylinder and gauge set connected to the compressor as shown in Figure 11-153, place the cylinder in a bucket of hot water which does not exceed 125°F.

CAUTION: Never heat refrigerant cylinder above 125°F. as tremendous hydrostatic pressures will develop, capable of rupturing cylinder. When there is a possibility of overheating cylinder, the cylinder must be opened to a suitable pressure relief mechanism at all times.

2. Place cylinder and bucket on a suitable scale and record the total weight.

3. Open the low pressure valve on the gauge set. (High pressure valve on the gauge set closed.)

4. Wearing goggles to protect eyes, fully open the refrigerant-12 cylinder valve and allow refrigerant-12 vapor to flow into the refrigerating system.

5. Operate engine and compressor at slow idling speed until a total of 4 pounds of refrigerant-12 have been charged into the 4400, 4600 and 4800 Series system or 3-1/2 pounds of refrigerant-12 in the 4700 Series system. It may be necessary to reheat the water in bucket to maintain required pressure.

6. Close both valves on gauge set, close valve on refrigerant-12 cylinder, and remove cylinder from bucket of water.

IMPORTANT: Whenever the refrigerant system is discharged and recharged, it is necessary to cycle the suction throttle valve several times to normalize the piston diaphragm in the valve. This is done on the 4700 by moving the air conditioner temperature control lever from one extreme to the other.

On the 4400-4600-4800, operate TEMP lever several times.

7. Perform functional test, paragraph 11-19.

8. After test is completed, remove gauge lines and replace protective caps over Schrader valve fittings and tighten securely.

11-19 AIR CONDITIONER FUNCTIONAL TEST

In order to determine if the air system is operating properly and efficiently, it should be functional tested. Functional testing the air conditioner is determining if the discharge air temperature at the air outlet located at right side of the instrument panel, suction pressure and discharge pressure are within the specifications at a particular ambient condition. See Figures 11-154 and 11-155.

11-20 AIR CONDITIONER TROUBLE DIAGNOSIS

NOTE: If a case is encountered on a 4700 Series where the air conditioner has a refrigerant leak and there has been difficulty detecting it, there is a possibility that the piston diaphragm in the suction throttling valve may be the cause of the leak. If the piston diaphragm is leaking, the refrigerant will be drawn into the engine intake manifold through the vacuum hose and there will be no indication that the suction throttle valve has an external leak. Thus, when checking the air conditioner system for leaks, remove the vacuum hose from the suction throttle valve vacuum diaphragm, wait several seconds to allow refrigerant to collect in the diaphragm and leak test at the vacuum hose connection on the diaphragm. If leak detector indicates a leak, it will be necessary to remove suction throttle valve and replace the piston diaphragm in the valve.

a. Inspection of Air Conditioner System

1. Check compressor belt tension. See Figures 2-47 and 2-48.

2. Inspect all connections for presence of oil on any of the refrigerant system parts which could indicate a refrigerant leak. If oil is evident, check for leaks and repair as necessary.

3. Check air outlet hoses for leaks or restrictions.

4. Check outer surface of condenser to be sure they are not plugged with dirt, leaves or other foreign material. Be sure to check between the condenser and radiator as well as the outer surfaces.

5. Check to insure the evaporator drains are open.

6. Check sight glass as instructed in subparagraph "c".

7. Check ambient air temperature and air temperature at right air outlet following instructions on functional test charts. See Figures 11-154 and 11-155. Temperature should correspond with those listed on chart. If temperatures do not compare, attach gauge set (Figure 11-153) and functional test air conditioner.

b. Diagnosis of Components

Listed below are the air conditioner components and the possible conditions that could be encountered with each unit if defective.

1. Compressor - Compressor malfunction will appear in one of four ways: noise, seizure, leakage, or low discharge pressures. Even resonant compressor noises are not cause for alarm; however, irregular noises or rattles are likely to indicate broken parts.

Seizure will be indicated by the failure of the compressor to operate, if the clutch is in good operating condition, and there is no break in the electrical continuity of the system. Continued operation of a seized or partially seized compressor will result in damage to the clutch. To check for seizure, de-energize the clutch and attempt to rotate the compressor shaft. If the shaft will not turn, the compressor is seized. Leakage of compressor refrigerant may be detected through routine leak detection.

Low discharge pressures may also be caused by insufficient refrigerant or a restriction elsewhere in the system. These should be checked out prior to compressor servicing.

2. Compressor Clutch - If the compressor is inoperative, the electrical leak to the clutch should first be checked. If there is current to the clutch and the compressor is not seized, the clutch is defective and should be repaired.

3. Condenser - There are two types of possible condenser malfunctions. The condenser may leak, resulting in loss of refrigeration and low system pressures, or the condenser may have a restriction, resulting in excessive compressor discharge pressures, and inadequate cooling. If a restriction occures and some refrigerant passes the restriction, icing or frost may occur on the external surface of the condenser in the area of the restriction. Also if the air flow through the condenser is restricted or blocked, high discharge pressures will result. It is important that the external fins of the condenser and radiator core are not plugged with bugs, dirt, etc.

4. Expansion Valve - If malfunction of the valve is suspected, make sure the power element bulb is in proper position, tightly attached, and well insulated from outside air temperatures. If this valve fails, it usually fails in the power element and thus the valve remains closed. This will be indicated by low suction and discharged pressures. Also the inlet screen could be plugged. The screen may be cleaned with liquid refrigerant.

TEST CONDITIONS 4400 - 4600 - 4800

1. Car doors and hood open.
2. Climate control set at AIR COND. RECIR. and AIR lever full on (blower on high).
3. TEMP. lever in off position. Vent knobs in off position.
4. All air conditioner outlets open.
5. Gauge set connected to Schrader valve fittings as shown in figure 11-153.
6. Test should be conducted in area with above 70°F. ambient temperature.
7. Ambient air temperature should be measured in immediate test area toward front of car.
8. A fan should be used in front of radiator grille to insure minimum differential between temperature of air passing over condenser through radiator grille and evaporator through body cowl screen.

TEST NO. 1: 4400 - 4600 - 4800

Set engine speed at 2,000 rpm.

The following table lists ambient temperature, evaporator and head pressures and right air outlet temperatures that can be expected from a normally-functioning unit.

NOTE: If evaporator pressure is not correct for indicated ambient temperature, adjust suction throttle valve following procedure in par. 11-15, sub-par. f.

NOTE: The lower outlet temperature can be achieved on dry days, and the higher on humid days.

Ambient Temperature °F	Evaporator Pressure PSIG	Compressor Head Pressure PSIG	Rt. Outlet Temperature °F
70	29-31	160-190	40-45
80	29-31	180-225	40-45
90	29-31	200-380	40-45
100	29-31	320-310	42-48
110	29-31	260-325	46-53

TEST NO. 2: 4400 - 4600 - 4800

This should be run on cars which will pass Test No. 1, but do not perform satisfactorily on the road. In this test the engine speed should be adjusted to the ambient temperature and humidity.

Ambient Temperature °F	Humidity	Engine R. P. M.	Evaporator Pressure PSIG	Compressor Head Pressure PSIG	Right Outlet °F
70	Humid	425-450	35	140	47
80	Dry	475-510	35	164	47
80	Humid	525-550	35	169	50
90	Dry	500-525	35	185	49
90	Humid	750-775	35	204	53
100	Dry	525-575	35	210	52
100	Humid	750-800	35	230	56
110	Dry	650-800	35	252	56
110	Humid	850-900	35	268	61

The pressures and outlet temperature should be equal to or lower than those tabulated above.

Figure 11-154—Air Conditioner Functional Test - 4400, 4600 and 4800 Series

Test Conditions - 4700 Series

1. Car windows and hood open, doors closed.
2. Air Conditioner Temp. and Air levers set at maximum cooling position.
3. All Air Conditioner outlets open.
4. Gage set connected to Schrader valve fittings as shown in Figure 11-153.
5. Heater defroster and ventilator controls in OFF position.
6. Test should be conducted in area with above 70°F. ambient temperature.
7. Ambient air temperature should be measured in immediate test area toward front of car.
8. A fan should be used in front of radiator grille to insure minimum differential between temperature of air passing over condenser through radiator grille and evaporator through body cowl screen.

Test No. 1: - 4700 Series

Set engine speed at 2000 rpm.

The following table lists ambient temperature, evaporator and head pressures and right air outlet temperatures that can be expected from a normally-functioning unit.

NOTE: If evaporator pressure is not correct for indicated ambient temperature, adjust suction throttle valve following procedure in par. 11-15, sub-par. f.

NOTE: The lower outlet temperature can be achieved on dry days, and the higher on humid days.

Ambient Temperature °F	Evaporator Pressure PSIG	Compressor Head Pressure PSIG	Rt. Outlet Temperature °F
70	20-22	160-190	37-41
80	20-22	190-210	39-43
90	20-22	220-240	43-46
100	20-22	250-270	47-50
110	22-25	280-300	51-54

Test No. 2: - 4700 Series

This should be run on cars which will pass Test No. 1, but do not perform satisfactorily on the road. In this test the engine speed should be adjusted to the ambient temperature and humidity.

Ambient Temperature °F	Humidity	Engine R.P.M.	Evaporator Pressure PSIG	Compressor Head Pressure PSIG	Right Outlet °F
70	Dry	500-525	26	122	36
70	Humid	500-525	26	138	38
80	Dry	525-550	26	155	41
80	Humid	675-700	26	190	45
90	Dry	725-750	26	200	44
90	Humid	975-1000	26	220	48
100	Dry	1000-1025	26	230	46
100	Humid	1100-1125	26	245	49
110	Dry	1200-1225	26	260	49
110	Humid	1675-1700	26	285	54

Figure 11-155—Air Conditioner Functional Test - 4700 Series

5. Evaporator - Dirt or other foreign matter on the core surface or in the evaporator case will restrict air flow. A cracked or broken case can result in insufficient air or warm air delivered to the passenger compartment. The condensation drains should be unrestricted.

6. Receiver Dehydrator - Leakage of refrigerant indicates a defective unit. The desiccant cannot easily be checked, but if it or the system has been exposed to outside air for a considerable length of time, the unit should be replaced.

Restrictions in the receiver-dehydrator can also cause system malfunction. If the inlet tube is blocked, it is likely to result in high head pressure. If the outlet tube is blocked, head pressure is likely to be low and there will be little or no cooling.

IMPORTANT: The IN stamped on receiver must be connected to the condenser.

7. Suction Throttle Valve (STV) - If the STV is defective it may cause evaporator pressure to be too high (air outlet temperature too warm) or it could cause the evaporator pressure to be too low (air outlet temperature too low which may cause icing of the evaporator core). Also if the vacuum diaphragm of the STV is defective, there would be no means of setting the STV to change the air outlet temperature. Refrigerant leakage of STV may be detected through routine leak detection. Before servicing the suction throttle, it should be determined that the STV is actually the cause of the complaint by following adjustment procedure in paragraph 11-15, subparagraph "f".

If tests indicate STV is defective, it should be removed, disassembled and repaired following procedure in paragraph 11-15, subparagraph "g" and "h".

c. Use of Receiver Sight Glass for Diagnosis

At temperatures higher than 70°F., the sight glass may indicate whether the refrigerant charge is sufficient. A shortage of liquid refrigerant is indicated after about five minutes of compressor operation by appearance of slow-moving bubbles (vapor) or a broken column of refrigerant under the glass. Continuous bubbles may appear in a properly charged system on a cool day. This is a normal situation. If the sight glass is generally clear and performance is satisfactory, occasional bubbles do not indicate refrigerant shortage.

If the sight glass consistently shows foaming or a broken liquid column, it should be observed after partially blocking the air to the condenser. If under this condition the sight glass clears and the performance is otherwise satisfactory, the charge shall be considered adequate.

In all instances where the indications of refrigerant shortage continues, additional refrigerant should be added in 1/4 lb. increments until the sight glass is clear. An additional charge of 1/2 lb. should be added as a reserve.

In no case should the system be overcharged.

COMPLAINT AND CAUSE	CORRECTION
1. Insufficient Cooling	
(a) Low air flow	(a) Check blower operation. Check for obstructions in air distribution system. Check for clogged evaporator. If iced, deice core and check adjustment and operation of suction throttle valve. Paragraph 11-15, subparagraph "f".
(b) Defective heater core manual water valve	(b) Check operation of valve. Adjust or replace as necessary.
(c) Heater, defroster, or ventilator controls not in the off position	(c) Advise operator of correct operation of controls.

NOTE: If none of the above items are cause of complaint of insufficient cooling, perform functional test on car. If car does not pass test see items 2, 3, 4 and 5 on this chart.

COMPLAINT AND CAUSE	CORRECTION
2. Compressor Discharge Pressure Too High	
(a) Engine overheated	(a) See Paragraph 2-7 for possible cause.
(b) Overcharge of refrigerant or oil in system	(b) Systems with excess discharge pressures should be slowly depressurized. (1) If discharge pressure drops rapidly, it indicates air (with possibility of moisture) in the system. When pressure drop levels but still indicates in excess of specifications shown in the FUNCTIONAL TEST CHART, slowly bleed system until bubbles appear in the sight glass and stop. Add refrigerant until bubbles clear, then add one-half pound of refrigerant. Recheck operational pressures. If system pressures still remain above specifications, and the evaporator pressure is slightly above normal, then a restriction exists in the high pressure side of the system. (2) If discharge pressure drops slowly, it indicates excessive refrigerant. If pressures drop to specifications and sight glass remains clear, stop depressurizing and recheck operational pressures. If pressures are satisfactory, depressurize until bubbles appear in the sight glass, stop depressurizing, then add one-half pound refrigerant. Recheck operational pressures. (3) If discharge pressure remains high after depressurizing the system, continue depressurizing until bubbles appear in the sight glass. If evaporator pressures also remain high, there is a possibility of a restriction in the high pressure side of the refrigeration system or the STV may require adjustment. See EVAPORATOR PRESSURE TOO HIGH.
(c) Restriction in condenser or receiver liquid indicator	(c) Remove parts, inspect, and clean or replace.
(d) Condenser air flow blocked	(d) Clean condenser and radiator core surfaces as well as the space between the condenser and radiator.
(e) Evaporator pressure too high	(e) See EVAPORATOR PRESSURE TOO HIGH.
3. Compressor Discharge Pressure Too Low	
(a) Insufficient refrigerant	(a) Check for presence of bubbles or foam in liquid indicator. If bubbles or foam are noted (after five minutes of operation), check system for leaks, if no leaks are found refrigerant should be added until sight glass clears, then add an additional 1/2 lb.

COMPLAINT AND CAUSE	CORRECTION
(b) Low suction pressure	(b) See EVAPORATOR PRESSURE TOO LOW.
(c) Defective compressor and/or broken compressor reed valves	(c) Repair compressor.
4. Evaporator Pressure Too High	
(This will be accompanied by air outlet temperature at outlet too high.)	
(a) Expansion valve capillary tube bulb not tight to evaporator outlet tube.	(a) Check for tightness.
(b) Expansion valve improperly adjusted or inoperative.	(b) Replace valve.
(c) Suction throttle valve adjusted improperly or defective	(c) Check operation of STV, paragraph 11-15, subparagraph "f". Repair valve, if necessary.
(d) Vacuum Modulator defective (4700)	(d) There should be no vacuum to STV when air conditioner temperature control lever on COOLER position and FAN switch lever on HIGH position. Replace vacuum modulator if defective.
5. Evaporator Pressure Too Low	
(a) Expansion valve capillary tube broken, inlet screen plugged or valve otherwise failed	(a) Replace valve or clean inlet screen of valve.
(b) Restriction in system tubes or hoses.	(b) Replace kinked tube or restricted hose.
(c) Suction throttle valve adjusted improperly or defective	(c) Check operation of STV, paragraph 11-15, subparagraph "f". Repair if necessary.

NOTE: If compressor suction line from STV is extremely colder than STV inlet line from evaporator, this indicates that STV outlet pressure is much lower than inlet pressure and STV may be defective.

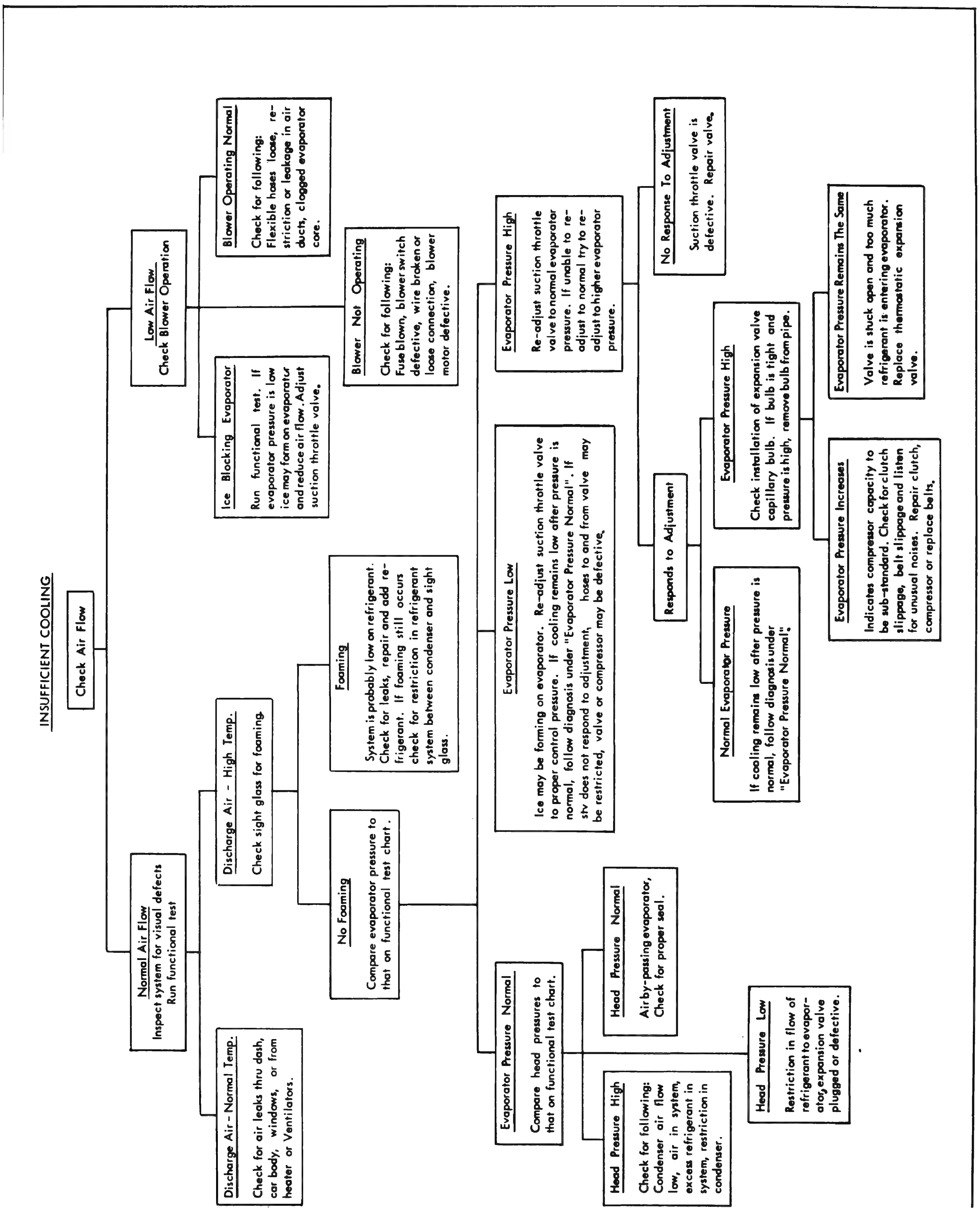


Figure 11-156—Air Conditioner Trouble Diagnosis Chart

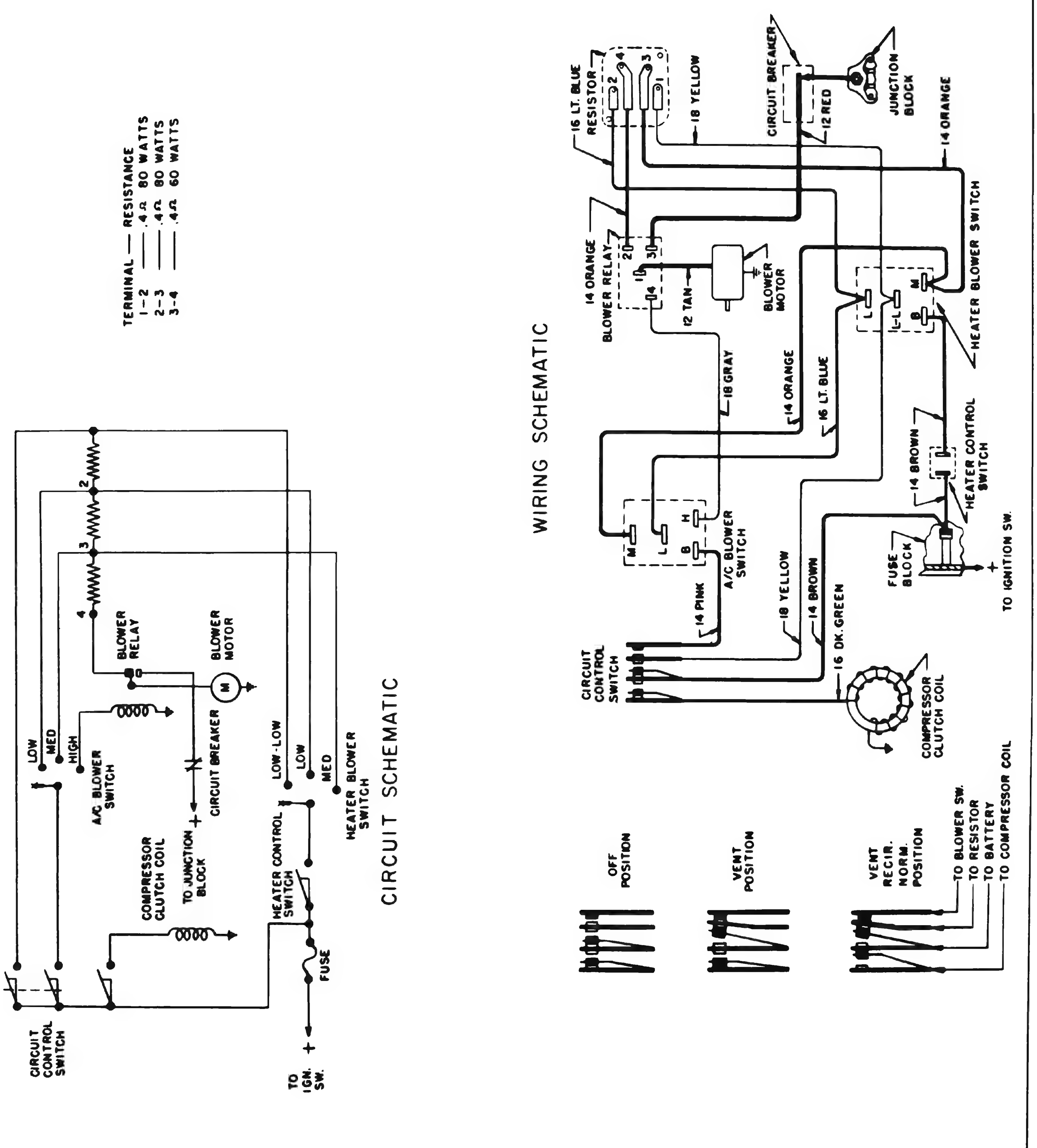


Figure 11-157—Heater-Air Conditioner Schematic - 4700 Series

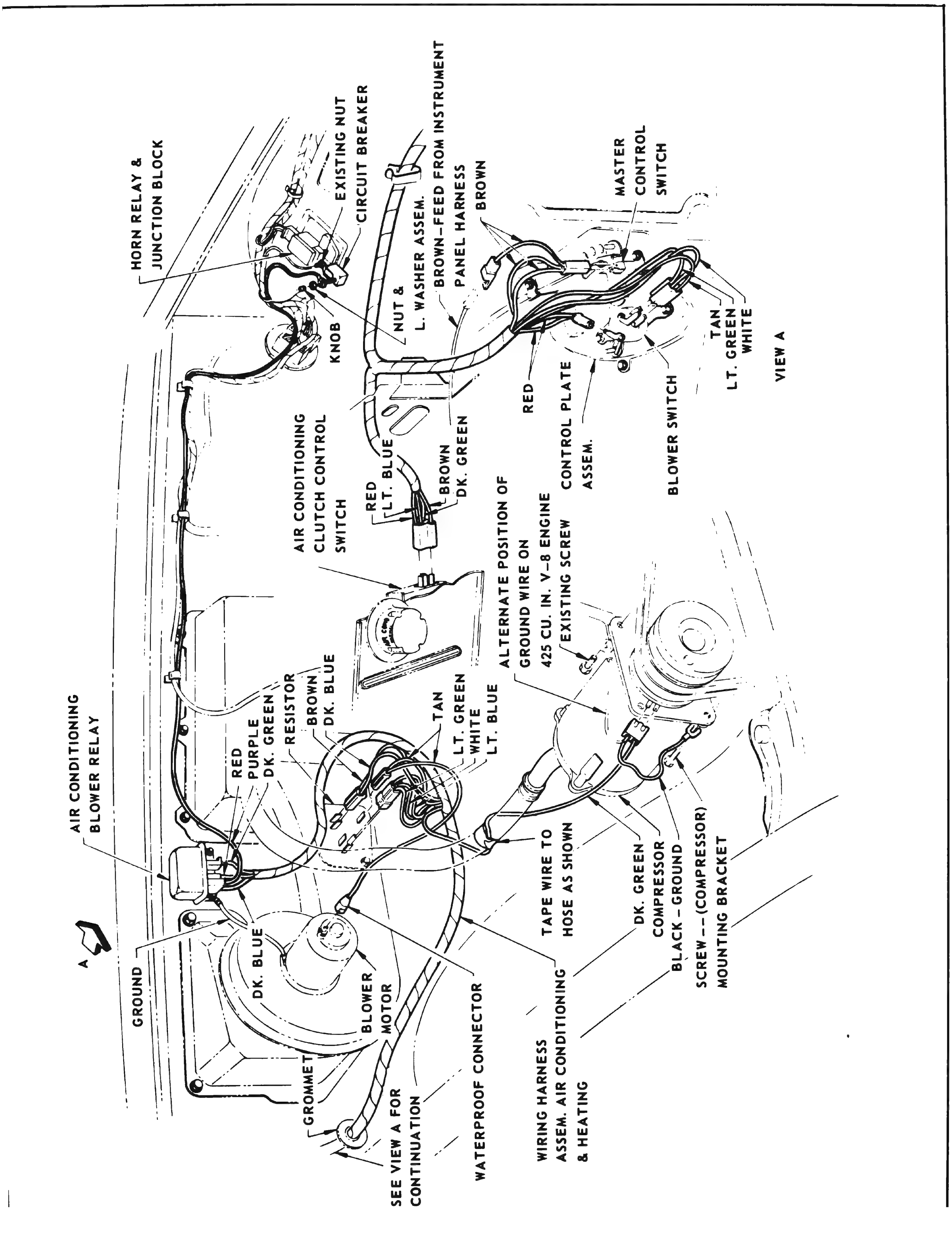


Figure 11-158—Heater-Air Conditioner Wiring Installation - 4400, 4600 and 4800 Series

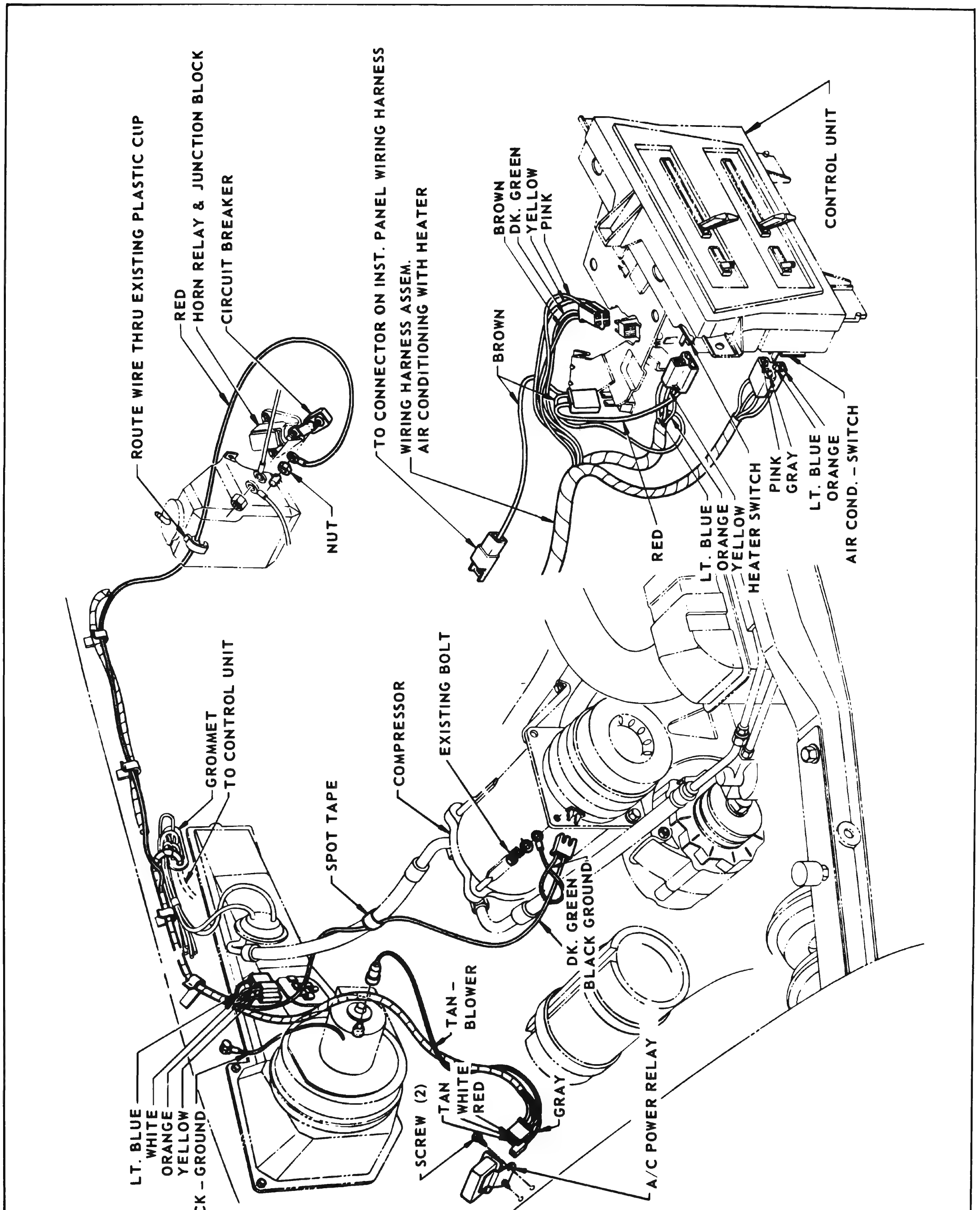


Figure 11-159—Air Conditioner Wiring Installation - 4700 Series

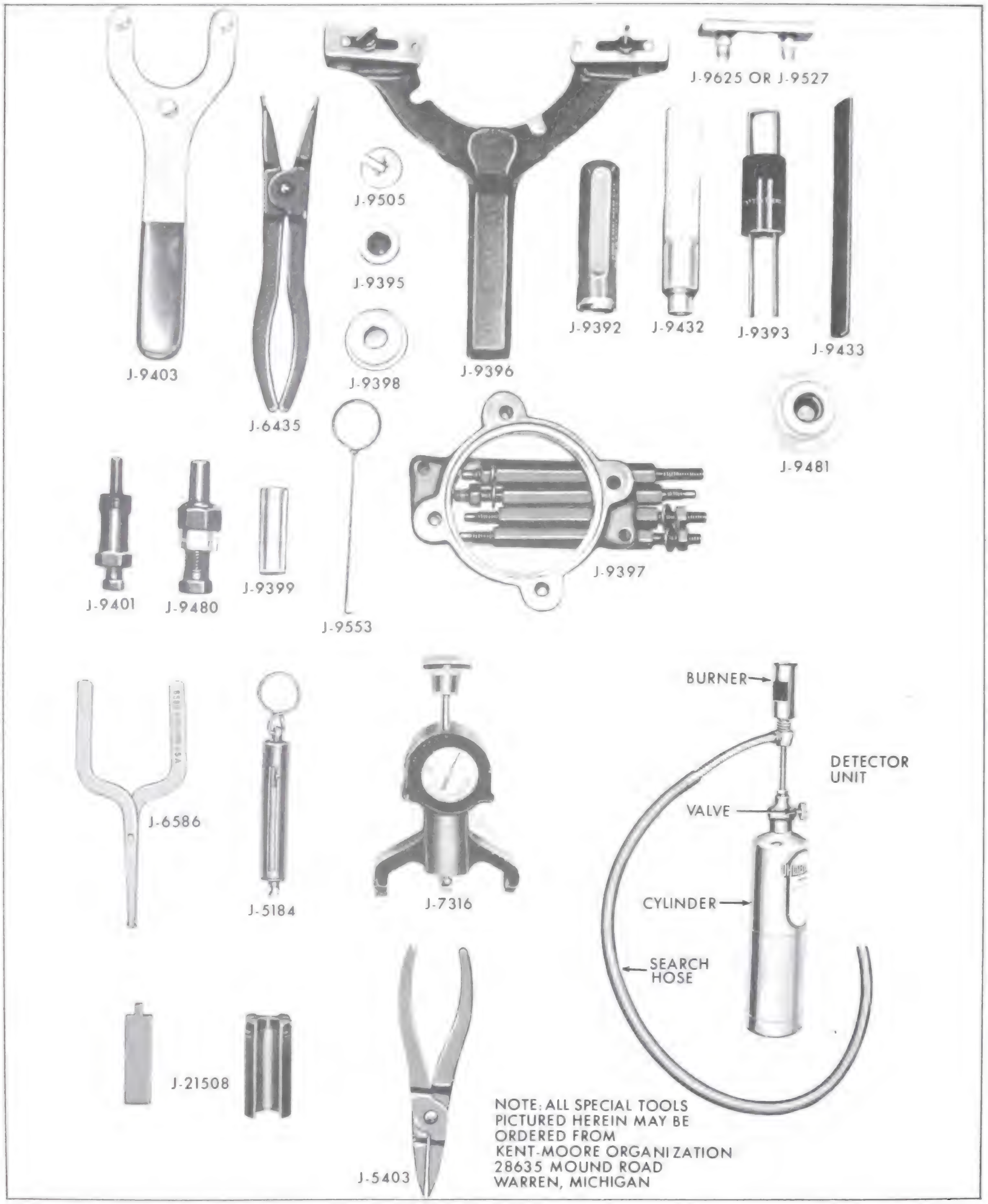


Figure 11-160—Air Conditioner Compressor Tools

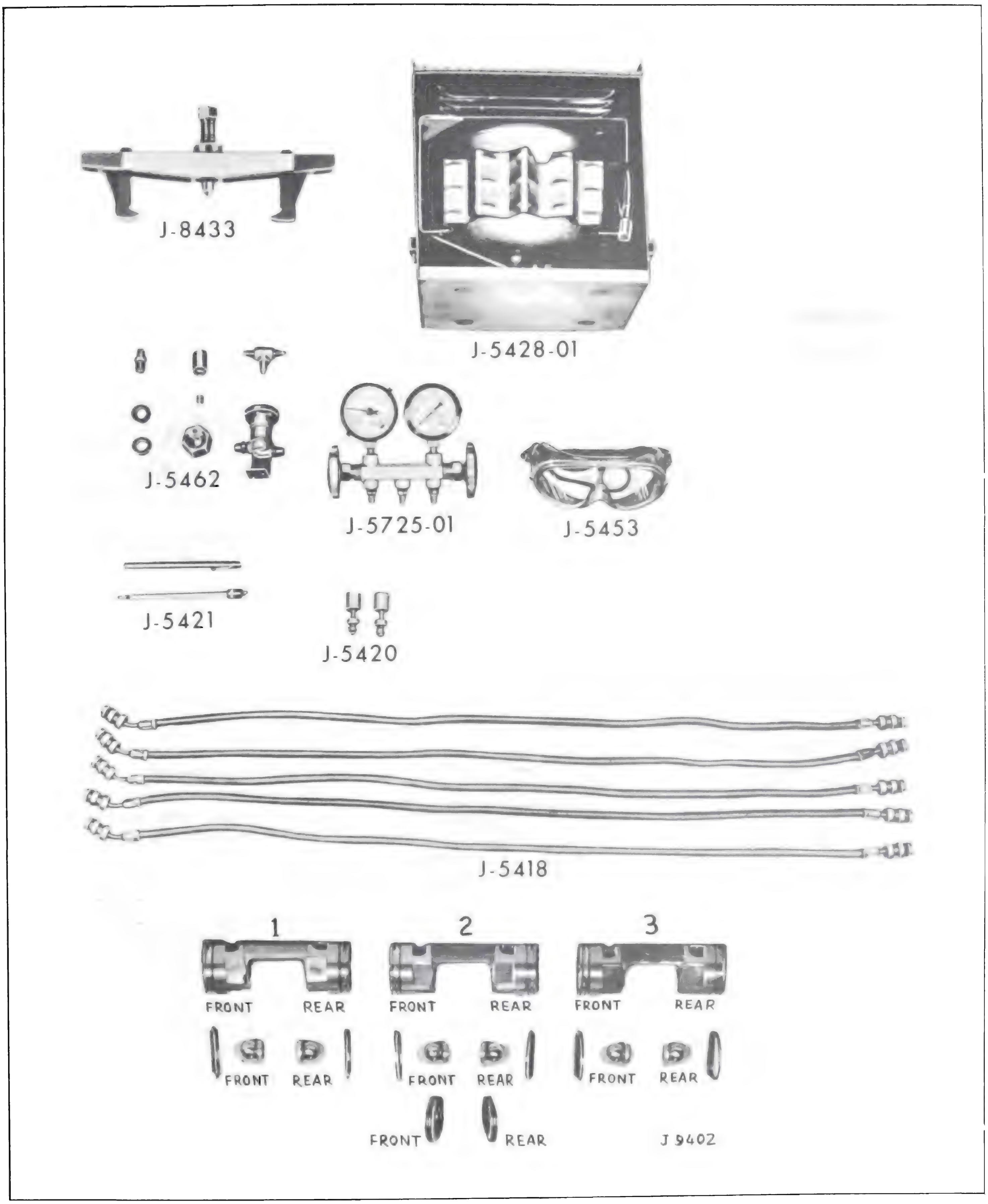


Figure 11-161—Air Conditioner Tools

SECTION 11-D

GUIDE-MATIC POWER HEADLAMP CONTROL

CONTENTS OF SECTION 11-D

11-21 GUIDE-MATIC POWER HEADLIGHT CONTROL

a. Description and Operation

The Guide-Matic is an electronic device which provides automatic switching of headlamps between upper and lower beam in response to light from an approaching vehicle.

The system consists of a phototube unit, amplifier unit, power relay, and a combination dimmer-override type foot switch. See Figure 11-162.

The phototube unit mounted on top of the instrument panel is the light sensing device which converts light into an electrical signal for use by the amplifier unit. A control knob is located on the rear of the unit and allows the driver to limit the amount of sensitivity of the unit. Manual operation of the headlights, by using the foot switch, may be obtained by rotating the control completely counterclockwise to the off position. See Figure 11-163.

The amplifier unit receives and amplifies the signal from the phototube unit into a signal strong enough to actuate the power relay. It is mounted on the lower edge of the dash under the glove box. See Figure 11-164.

The power relay has special heavy duty contacts for switching headlamp beams. It is located on the left side of the steering column brace.

Figure 11-163—Guide-Matic Phototube

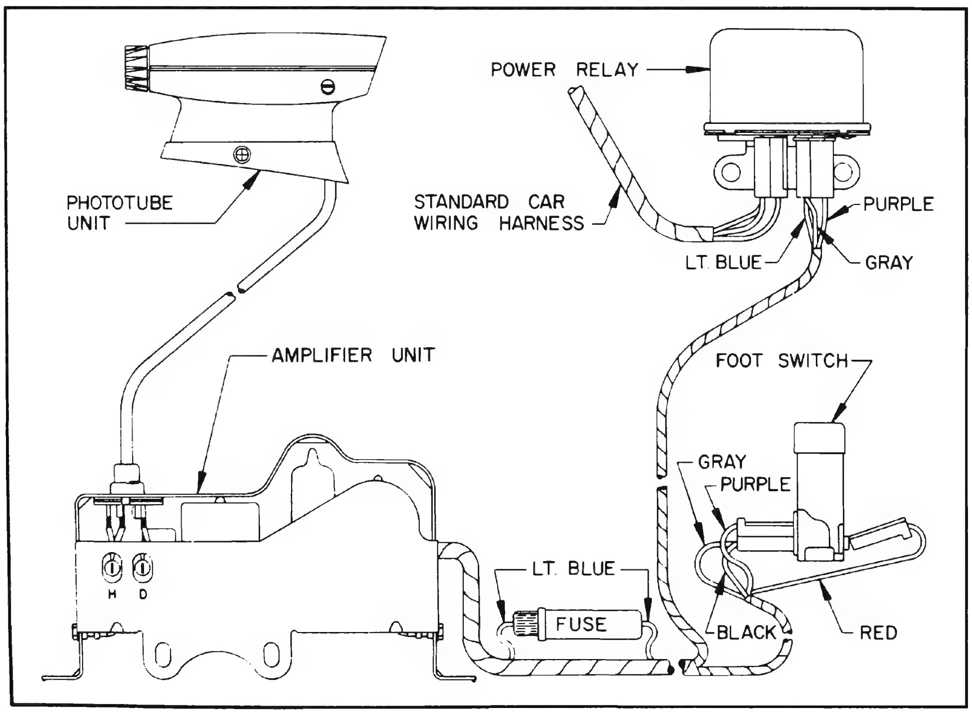


Figure 11-162—Guide-Matic Circuit Diagram

The dimmer-override foot switch provides automatic control of the headlamp beams in one position, and manual low beams in the other position. In automatic position, a spring loaded momentary contact type switch is also provided. Depressing the foot switch slightly provides an overriding upper beam condition regardless of light on the phototube unit. This permits the driver to signal if an approaching vehicle fails to switch to low beam, and also, in a lighted area provides a simple test for automatic position of the foot switch.

The Guide-Matic is connected to turn on with the headlamps. After approximately 30 seconds warm-up period, the Guide-Matic will provide complete automatic switching of the headlamp beams.

Street lights and other extraneous lights encountered in the city are sufficient to maintain its vehicle headlamps on low beam. Occasionally, when trailing an older model car with poor lighting on the rear, or due to some other unfavorable condition, it may be desirable to change the foot switch position to manual low beam. The Guide-Matic is disconnected from its vehicle headlamps in this position, but is not turned off. It continues to function as long as vehicle headlamps are turned on.

b. Trouble Shooting:

1. Determination of Complaint -

Turn Guide-Matic on and allow at least one minute warmup.

In a lighted area, the headlamps should be on low beam in both positions of the foot switch. If not, go to "Headlamps Stay On Upper Beam."

With black cloth over the phototube unit, the headlamps should be on upper beam in one position of the foot switch. If not, go to "Headlamps Stay On Lower Beam".

With the black cloth removed from the phototube unit, in one position of the foot switch, upper beam should be obtained by depressing the foot switch 1/4 inch. If not, go to "No Overriding Upper Beam".

If customer complains of the Guide-Matic dimming too late or too soon, go to "Sensitivity Adjustment".

2. Preparation

NOTE: IF CAR HAS BEEN IN THE SUN IMMEDIATELY PRIOR TO CHECKING, ALLOW TO COOL IN A COVERED PLACE FOR APPROXIMATELY ONE HOUR BEFORE THE CHECKS ARE MADE.

(a) Turn on headlamps.

(b) Allow minimum of one minute warmup.

(c) Follow tests progressively under the specific complaint until trouble is located.

3. Headlamps Stay On Low Beam:

(a) Remove the phototube unit harness from the amplifier unit and operate the foot switch.

(1) If headlamps are on low beam in both positions of the foot switch, go to Step b.

(2) If headlamps are on upper beam in one position of foot switch, trouble is in the phototube unit. Remove both units for servicing.

b. Remove the 4 amp fuse from the fuse holder near the amplifier unit and ratchet the foot switch.

(1) If the headlamps change beams, the amplifier unit is faulty and should be removed for servicing.

(2) If upper beam is not obtained, trouble is in power relay, foot switch, or car harness.

4. Headlamps Stay On Upper Beam:

(a) Ground the white wire of the phototube harness. (It may be necessary to lower amplifier. If so, use external ground for case of amplifier.)

(1) If headlamps remain on upper beam, go to Step b.

(2) If headlamps go to lower beam, trouble is in the phototube unit. Remove amplifier and phototube unit for servicing.

(b) Remove red wire from foot switch -

(1) If headlamps go to low beam, replace foot switch.

(2) If headlamps remain on upper beam, check power relay and if okay, remove amplifier for servicing.

5. No Overriding High Beam

(a) Check to see if red wire is connected to foot switch. If not, make correction.

(b) If it is, remove red wire and place a jumper from the red wire to ground. If override is obtained, replace foot switch.

(c) If override is not obtained, trouble is in the amplifier. Remove amplifier for servicing.

c. Removal and Installation

If diagnosis indicates that the phototube unit must be removed for repair by an authorized warranty repair dealer (United Motors Service), the amplifier unit should also be removed and sent with the phototube unit. If the amplifier unit must be removed for repair, the phototube unit need not be sent with it if diagnosis indicates it was operating satisfactorily. If car is to be driven before part is reinstalled, connect car wiring harness to foot switch to give manual operation of headlights at dimmer switch.

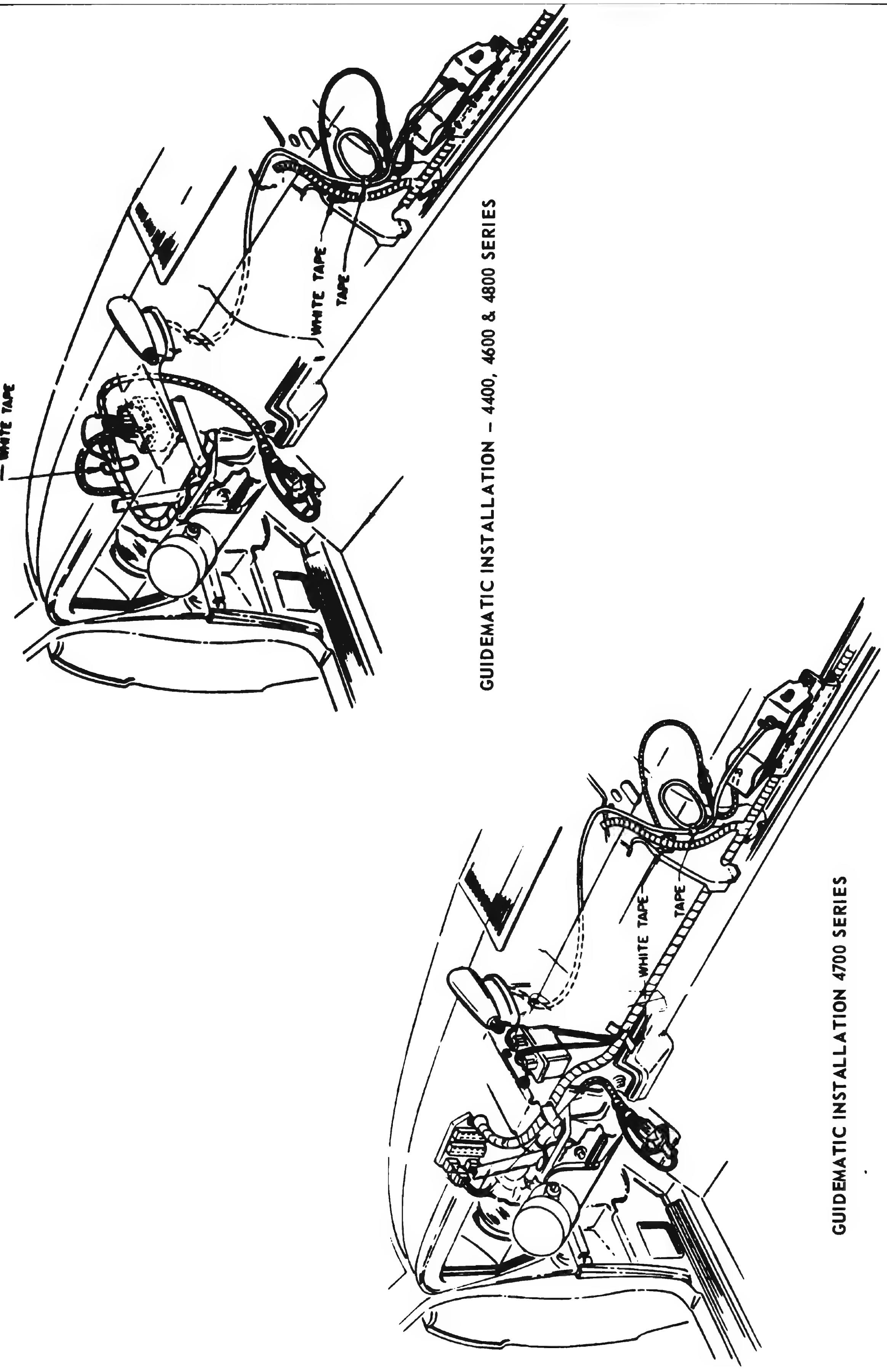
NOTE: Disconnect battery ground cable before removing Guide-Matic unit.

1. Phototube Unit

(a) Disconnect phototube wire from amplifier.

(b) Remove the Phillips head pivot pin from right side of phototube unit base, then lift the unit off the base and remove phototube unit and harness. See Figure 11-165.

(c) To install, reverse the procedure. Check vertical aim and dim and hold sensitivity adjustments. See subparagraph d.



GUIDEMATIC INSTALLATION – 4400, 4600 & 4800 SERIES

GUIDEMATIC INSTALLATION 4700 SERIES

Figure 11-164—Guide-Matic Installation

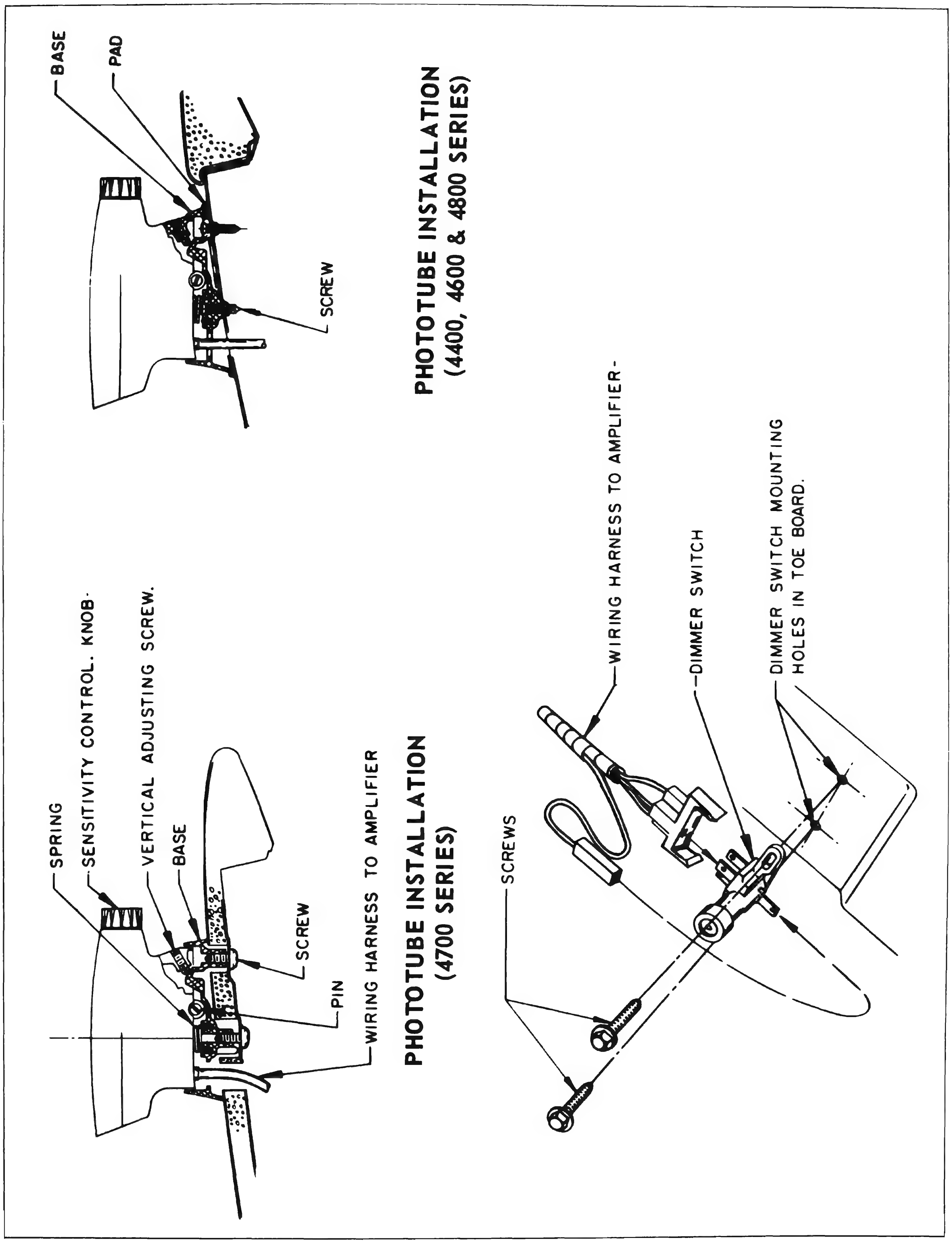


Figure 11-165—Phototube and Dimmer Switch Installation

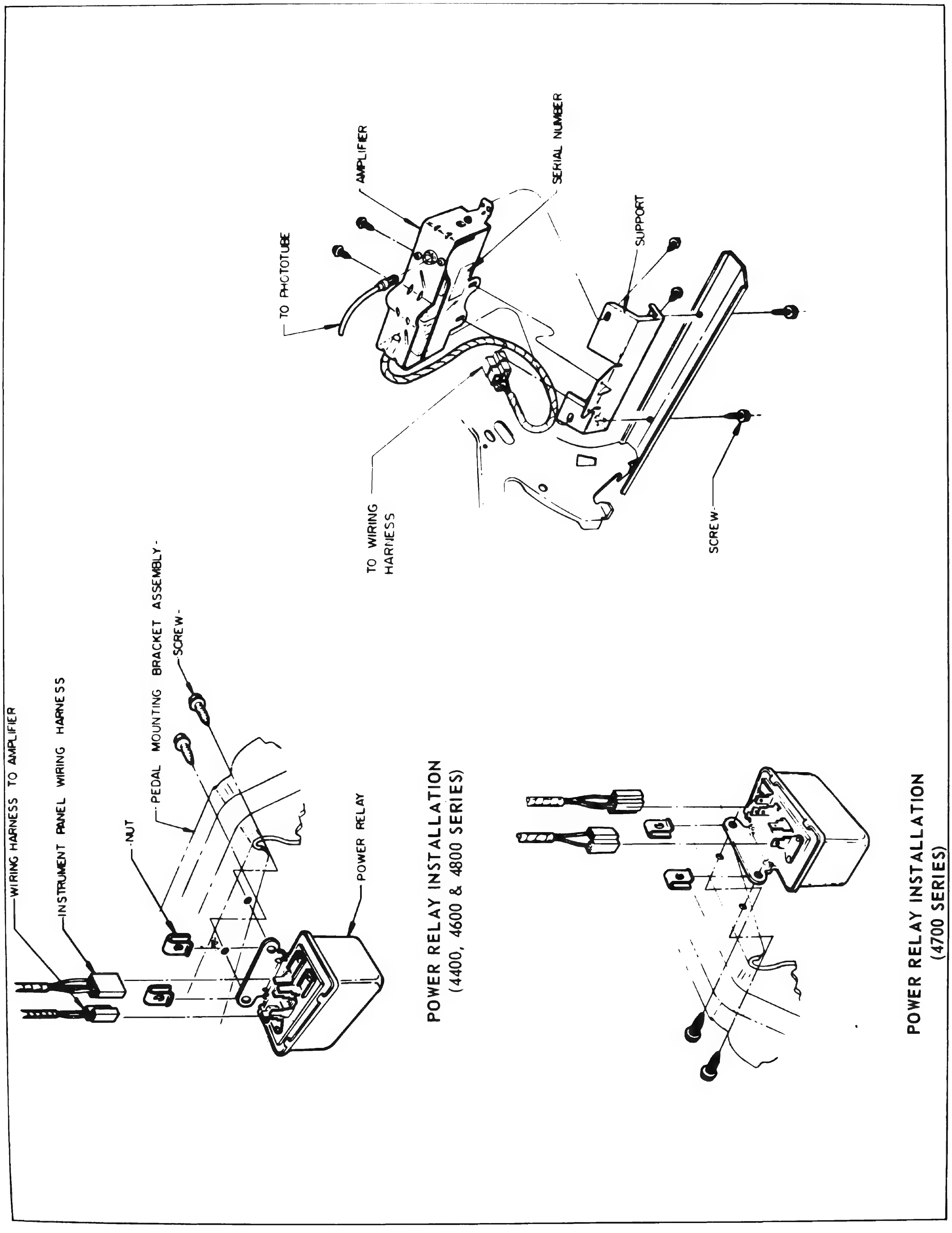


Figure 11-166—Amplifier and Power Relay Installation

2. Amplifier Unit

(a) Disconnect foot switch harness from foot switch.

(b) Disconnect phototube harness from amplifier. See Figure 11-166.

(c) Remove the amplifier attaching screws.

(d) To install, reverse the procedure. After installing the amplifier unit, check the dim and hold sensitivity adjustments. See subparagraph d.

d. Adjustments and Tests

Tester J-8465, made by Kent-Moore, is required for checking or adjusting the Guide-Matic. The tester includes a vertical aiming device No. 6 and a sensitivity test lamp. See Figure 11-167.

CAUTION: Do not reverse the polarity of Tester J-8465 as damage may result to the tester and/or Guide-Matic units.

1. Phototube Unit Vertical Aiming Procedure

Proper performance of the Guide-Matic power headlight control requires that the phototube unit be accurately aimed vertically. If the unit is aimed too low, back reflections from the headlamps which are being controlled will lock the amplifier on low beam. However, the unit must be aimed as low as possible to provide maximum tolerance for car loading.

(a) Phototube unit vertical aiming should be done with car unloaded, truck empty except for spare tire, gas tank at least half full, and with tires at correct pressure.

(b) Locate car on a level floor (level within 1/4" fore and aft of car).

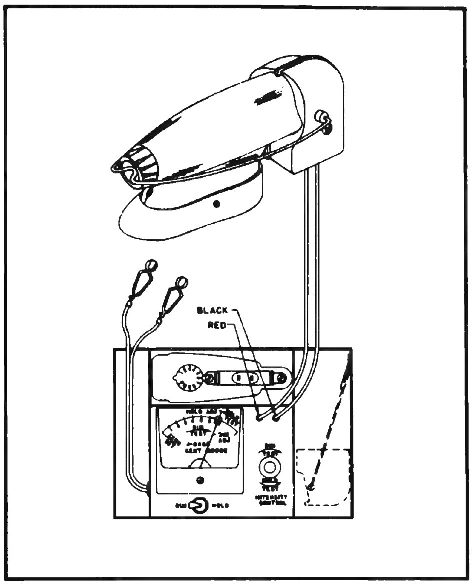


Figure 11-167—Tester J-8465

(c) Rock car sideways to equalize springs.

(d) Set Aiming Device No. 6 on top of phototube unit as shown in Figure 11-168.

(1) The three points on aiming device must be resting on top of phototube unit.

(2) The aiming device must be touching front of phototube unit.

(e) Set aiming dial of aiming device to 6.

(f) Adjust vertical aim screw until bubble is centered in level.

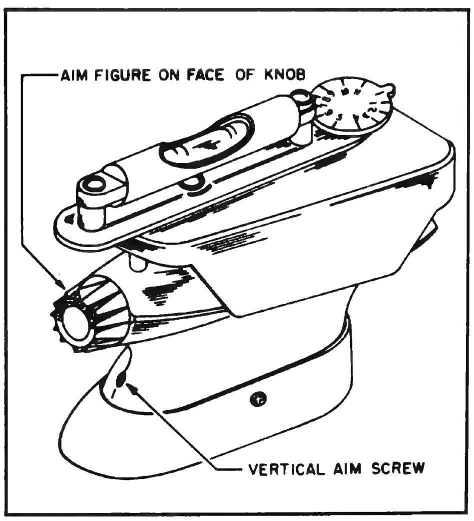


Figure 11-168—Aiming Device Installed

2. Dim and Hold Sensitivity Tests

CAUTION: Phototube unit must be covered with a black cloth during test. Tests of adjustments on the Guide-Matic should be made with the phototube unit below 100°F. If car has been in the sun immediately prior to checking, allow it to cool in a covered place for approximately one hour before the check is actually made.

(a) Preparation for Tests

(1) Set driver sensitivity control to detent position (fully counterclockwise).

(2) Install Tester Lamp. (Use Kent-Moore Model J-8465). See Figure 11-163.

(3) Start engine and operate at fast idle while making adjustments.

(4) Turn headlamps on and wait at least 5 minutes for amplifier unit to stabilize. Place foot switch in automatic position.

(5) Turn zero corrector on face of meter until meter pointer is on ZERO SET line. See Figure 11-163.

(6) Turn Tester INTENSITY CONTROL counterclockwise.

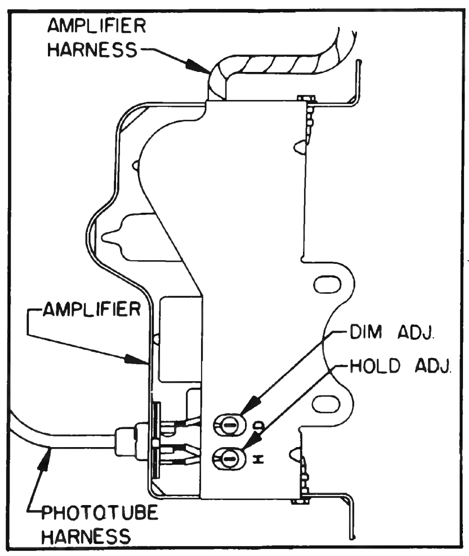


Figure 11-169—Amplifier Adjustments

(7) Connect battery leads of Guide-Matic tester to battery terminals.

(b) Dim Sensitivity Test

(1) Rotate tester INTENSITY CONTROL completely counter-clockwise.

(2) Turn DIM-HOLD switch to HOLD position and then back to DIM position. Headlamp should be on upper beam.

(3) Turn tester INTENSITY CONTROL clockwise slowly just to point where headlamps switch to lower beam. The meter pointer should now read in the black DIM ADJ. range on the meter scale. See Figure 11-163. If not, proceed to the hold and dim sensitivity adjustments.

(c) Hold Sensitivity Test

(1) Turn INTENSITY CONTROL all the way clockwise.

(2) Turn DIM-HOLD switch to DIM position and back to HOLD position to obtain a lower beam.

(3) Slowly turn INTENSITY CONTROL counterclockwise just to the point where headlamps switch to upper beam. The meter pointer should now read in the green HOLD ADJ. range on the meter scale. See Figure 11-163. If not, proceed to the hold and dim sensitivity adjustments.

3. Hold and Dim Sensitivity Adjustments

CAUTION: Hold sensitivity must be properly adjusted before adjusting dim sensitivity. Phototube unit must be covered with a black cloth during adjustments.

(a) Preparation for Adjustments. Same as preparation for tests above.

(b) Hold Sensitivity Adjustment

(1) Hold and dim sensitivity controls are slotted for screwdriver adjustment and are located at the side of the amplifier unit. See Figure 11-169.

(2) Rotate the amplifier hold control completely clockwise.

(3) Rotate tester INTENSITY CONTROL all the way clockwise.

(4) Turn DIM-HOLD switch momentarily to DIM position to switch lights to lower beam, then switch back to HOLD position. position.

NOTE: If lights do not switch to lower beam, the amplifier dim control must be turned completely clockwise and then readjust after hold adjustment is correct.

(5) Adjust INTENSITY CONTROL slowly counterclockwise until meter pointer is on HOLD ADJ. line. See Figure 11-163.

(6) Turn amplifier hold control slowly counterclockwise just to the point where headlamps switch to upper beam. Do not go beyond this setting.

(7) Recheck sensitivity as shown in Steps (1) through (3) under Hold Sensitivity Test.

(c) Dim Sensitivity Adjustment

NOTE: Dim sensitivity should not be adjusted until after hold sensitivity is properly adjusted.

(1) Rotate amplifier dim control completely counterclockwise. See Figure 11-165.

(2) Momentarily turn DIM-HOLD switch to HOLD then back to DIM position to obtain upper beam. See Figure 11-165.

(3) Adjust tester INTENSITY CONTROL until meter pointer is at DIM ADJ. line. See Figure 11-165.

(4) Slowly rotate amplifier dim control clockwise just to point where headlamps switch to lower beam. Do not go beyond this setting.

(5) Recheck sensitivity as shown in Steps (1) through (3) under Dim Sensitivity Test. If sensitivity is not correct, repeat adjustment procedure.

(6) If adjustment is correct, turn off headlamps and disconnect Kent-Moore tester.

(7) Remove tester lamp from the phototube unit.

SECTION 11-E

ELECTRO-CRUISE

CONTENTS OF SECTION 11-E

11-22 DESCRIPTION AND OPERATION OF ELECTRO-CRUISE

a. Description

The Electro-Cruise is a constant speed regulating system capable of accurate control of car speed over a wide range of road loads. Within the limits of the system, a speed range of 30 to 90 MPH can be accurately held within 2-1/2 MPH of the particular speed setting. Unlike a constant throttle device which locks the throttle in a selected position resulting in speed variation according to the varying road conditions, the Electro-Cruise system compares a measurement of car speed with the selected speed to maintain the selected speed under varying road conditions.

The Electro-Cruise is offered as optional equipment on 4400, 4600, 4700 and 4800 Series.

The Electro-Cruise is an electronic-pneumatic system which consists of a power unit, mounted on the cowl in the engine compartment and connected to the throttle linkage through a bead chain; an amplifier and relay control assembly mounted under the dash on the instrument panel mounting bracket; a speed transducer which is an integral part of the speedometer; an engagement switch and CRUISE lamp assembly, mounted on the top edge of the instrument cluster assembly; and a cruise release switch located on the brake pedal arm support bracket. See figure 11-171.

In operation, electrical signals from the speed transducer operate a vacuum switch which ports engine vacuum to the power unit. Through constant signals from the speed transducer, the power unit assumes its proper position to control the throttle opening. The electronic amplifier, engagement switch and brake release switch are the auxiliary components necessary to engage and disengage the system.

1. SPEED SETTING - The speed setting pointer moves over the existing speedometer scale and is set to the desired speed by rotating the speed setting knob at the bottom of the speedometer. See figure 11-172. The desired speed can be set either with the system engaged or disengaged; however, car speed will only be controlled by the Electro-Cruise when the system is engaged. If the speed setting is changed while the system is engaged, car speed will increase or decrease automatically to coincide with the desired setting.

2. ENGAGEMENT - The engagement switch lever and CRUISE lamp assembly is located to the left of the speedometer on 4400, 4600 and 4800 Series cars and fully controls the engagement of the system. See figure 11-172. On 4700 Series cars the unit will be located to the right of the steering column. To engage the system, it is necessary only to depress the engagement lever until the CRUISE lamp lights indicating the Electro-Cruise is in operation. If car is at or above the speed setting when the engagement lever is depressed, the CRUISE lamp will come on immediately. If car speed is below the speed setting, it is necessary to hole the engagement lever forward until the car has accelerated to the set speed to cause the CRUISE lamp to light. Use of the accelerator pedal is not necessary to obtain the desired set speed with the engagement lever held forward as the Electro-Cruise will automatically accelerate the car to this speed.

However, for faster acceleration to the set speed, the car may be brought up to speed by means of the accelerator pedal and then engaged by depressing the engagement lever when the car is within 2-1/2 MPH of the set speed or above.

3. DISENGAGEMENT - The Electro-Cruise can be disengaged by a touch of the brake pedal, by pulling the engagement lever rearward or by turning the ignition switch to the OFF or LOCK positions. Each of these will restore full accelerator pedal control to the driver. Once the Electro-Cruise has been disengaged, it is necessary to re-engage it again using the engagement lever to restore operation of the system.

4. OVERRIDE - Electro-Cruise system in no way prevents or hinders increases in throttle

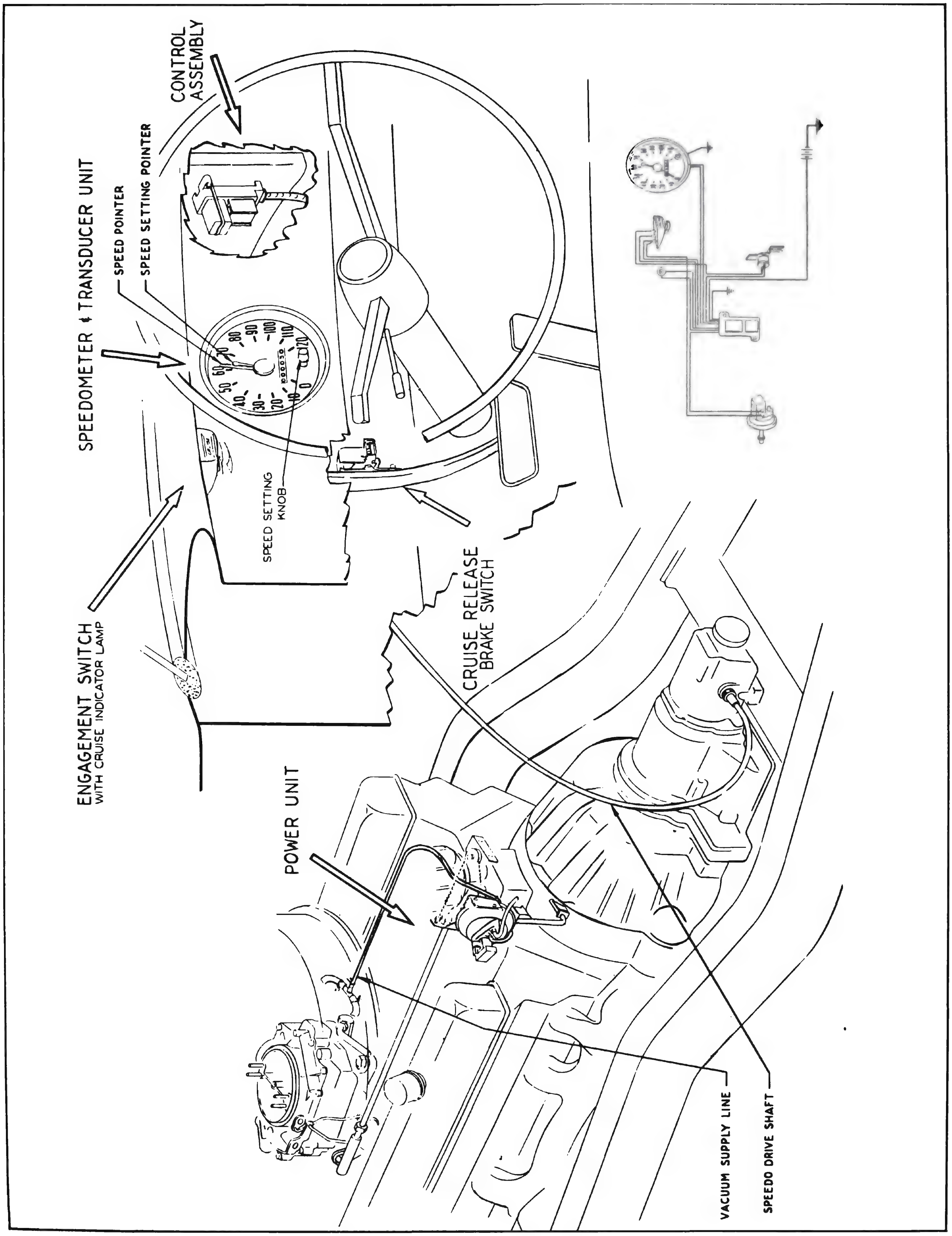


Figure 11-171—Electro-Cruise Components - 4400, 4600 and 4800 Series

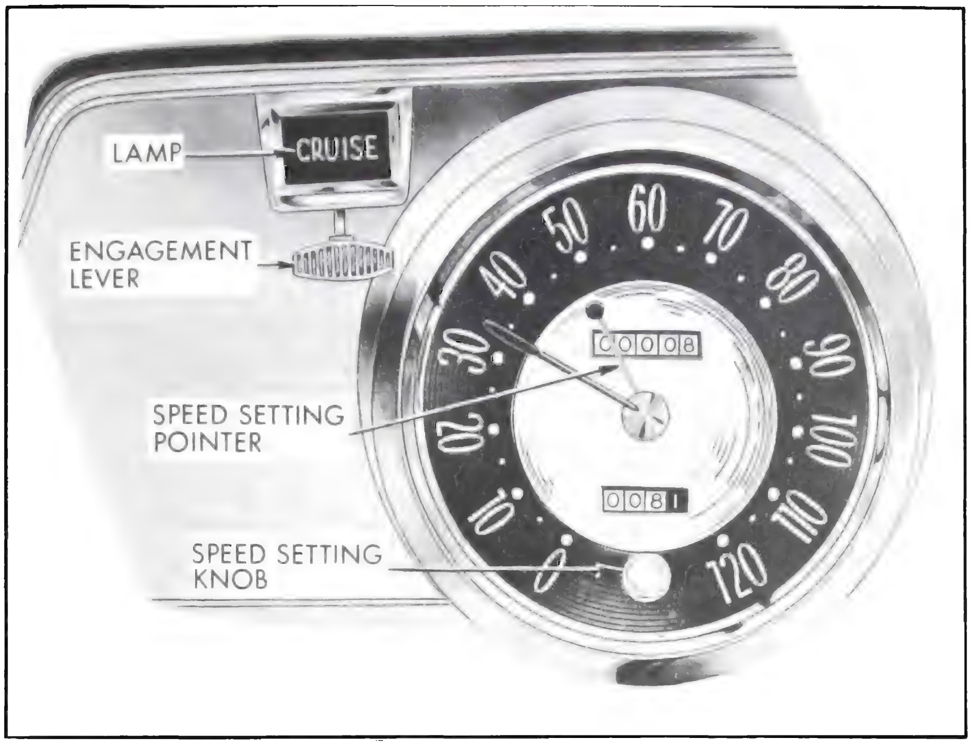


Figure 11-172—Electro-Cruise Controls - 4400, 4600 and 4800 Series

angle through use of the accelerator pedal. Therefore, if a higher speed is momentarily desired when the system is in operation, the accelerator pedal may be depressed in the normal manner to override the Electro-Cruise. When the accelerator pedal is released, the Electro-Cruise will again maintain the desired set speed without re-engagement.

5. SAFETY PRECAUTIONS - For obvious safety reasons, the Electro-Cruise should not be used in areas where conditions are not adapted to maintain a constant speed, such as in city-type traffic, winding or hilly roads, bad weather, etc. The Electro-Cruise should not be engaged when the car is being driven on snow, ice or mud.

b. Operation

1. POWER UNIT - The power unit is basically a pneumatic chamber and porting valve consisting of: an aluminum housing and cover; a power diaphragm and bead chain assembly; a disphragm return and speed control compensating spring; and air orfice; a vacuum orfice; a control valve; a control valve return spring; a control valve coil; an air filter; and brake release line fitting. See figure 11-173.

In operation, the power unit receives an electric signal from the electronic control unit which, according to the dictates of the speed transducer, ports the proper vacuum and air mixture into the unit to maintain the desired road speed. The signal which is received by the power unit during normal cruise operation, cycles the control valve armature between the atmosphere and vacuum ports allowing the armature to dwell on the ports for time intervals depending upon the shape of a square wave electrical output from the speed transducer.

When the control valve coil is energized, the "teeter-totter" armature of the control valve is pulled down against spring tension, closing the air port to atmosphere and opening the vacuum port to the diaphragm chamber. The vacuum admitted, then, tends to increase tension on the bead chain to open the throttle valve.

Similarly, when the control valve coil is not energized, spring tension positions the "teeter-totter" armature of the control valve to close the vacuum port and open the air port to the diaphragm chamber. The air admitted, then, tends to reduce tension on the bead chain to close the throttle valve.

Thus through continual cycling of the control valve, a vacuum level is produced in the diaphragm chamber proportional to the demands of the speed transducer and the tension of the bead chain balances the force of the existing throttle return spring to maintain the required throttle angle. Maximum throttle angle allowed by the power unit is approximately 35°; therefore, when the control valve coil is continuously energized, car acceleration will be held at this angle. In addition, the maximum speed of 90 MPH is determined by this maximum throttle opening.

2. SPEEDOMETER AND SPEED TRANSDUCER - The speed transducer is integral with the speedometer and utilizes a cam, cam follower, oscillating contact spring and pickup arm to control the electrical impulses reflected from the electronic control unit to the power unit. See figure 11-174. Position of the oscillating contact pin, which determines the set speed, is adjusted by rotating the cam follower mounting ring through a gear arrangement with the speed setting shaft and knob assembly. Rotating the cam follower mounting ring also moves the speed setting pointer to indicate the relative position of the oscillating contact pin, and, therefore, indicate the actual set speed.

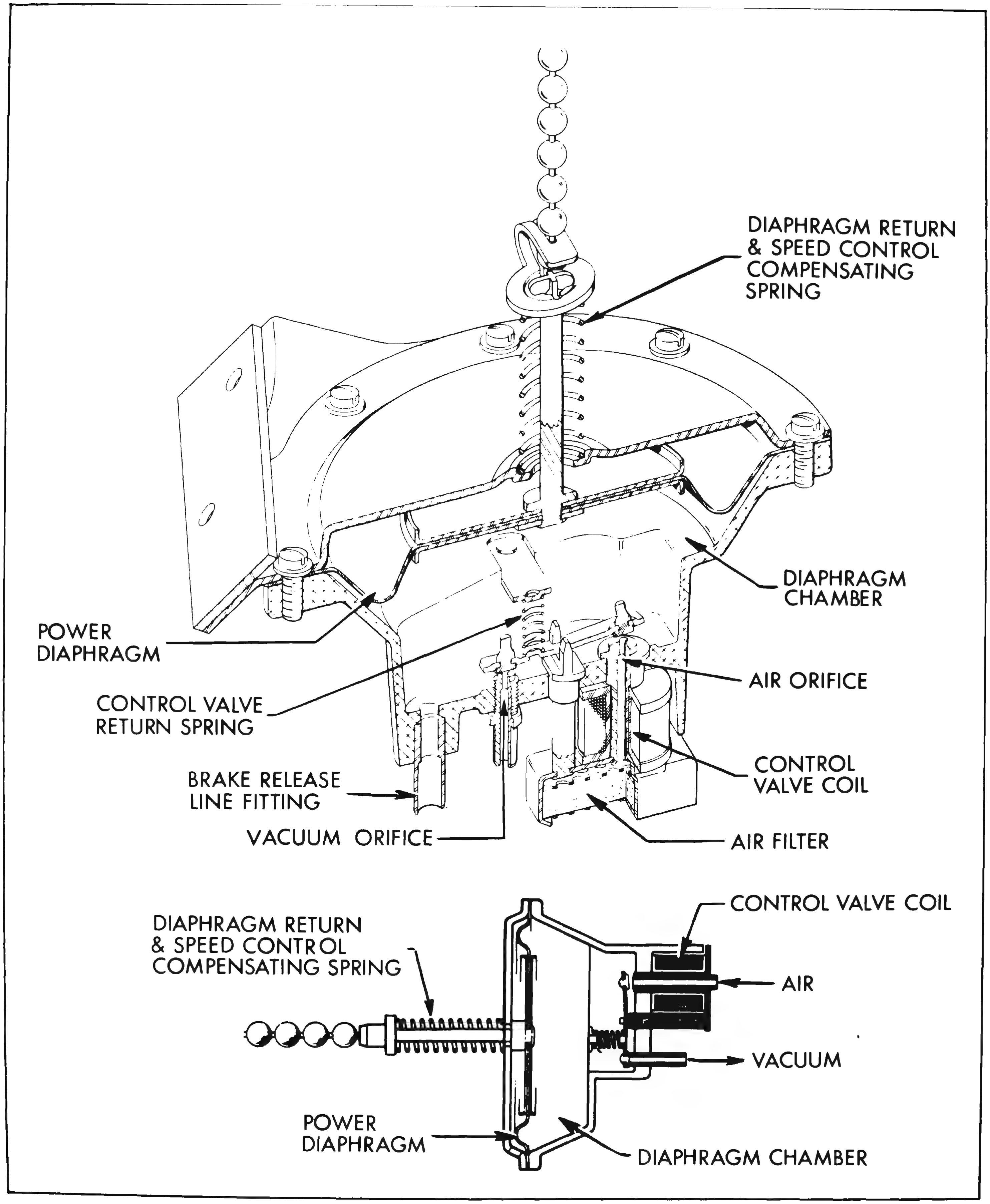


Figure 11-173—Power Unit

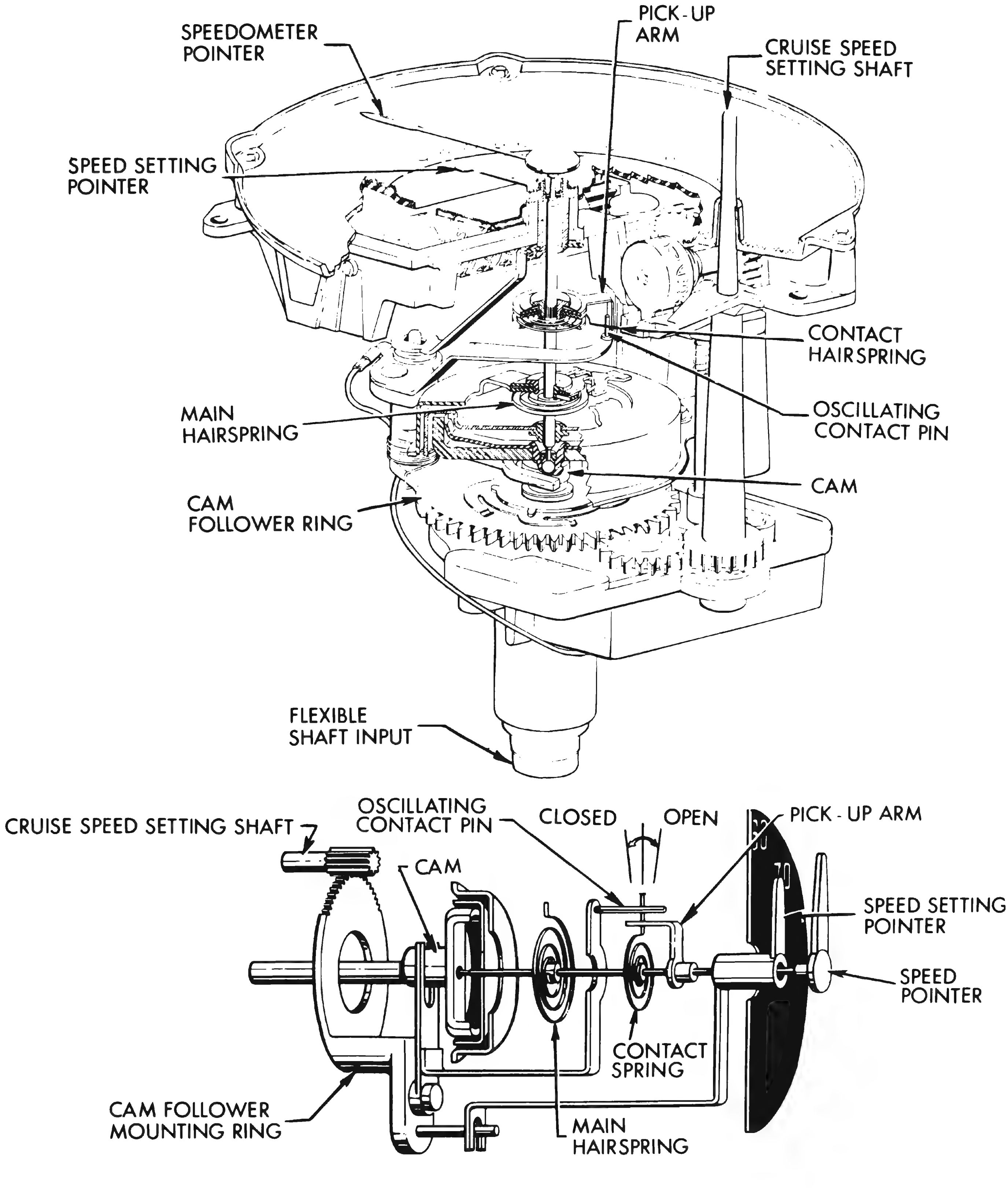


Figure 11-174—Speedometer and Speed Transducer

When the Electro-Cruise is in operation at the desired set speed, the cam which is mounted to the input shaft oscillates the cam follower to cause oscillation of the contact pin. During one-half of the oscillation, the contact pin will contact the contact spring to complete an electrical circuit to the electronic control unit. During the other one-half of the oscillation, the contact spring is held away from the contact pin by the pickup arm to open the electrical circuit to the electronic control unit. The angle of contact oscillation, or range of proportional control corresponds to a speed of 5 MPH and reflects a square wave electrical impulse to the electronic control unit. See figure 11-175.

As car speed increases within 2-1/2 MPH above the set speed, the pickup arm moves the contact pin to allow the circuit to the electronic control unit to remain

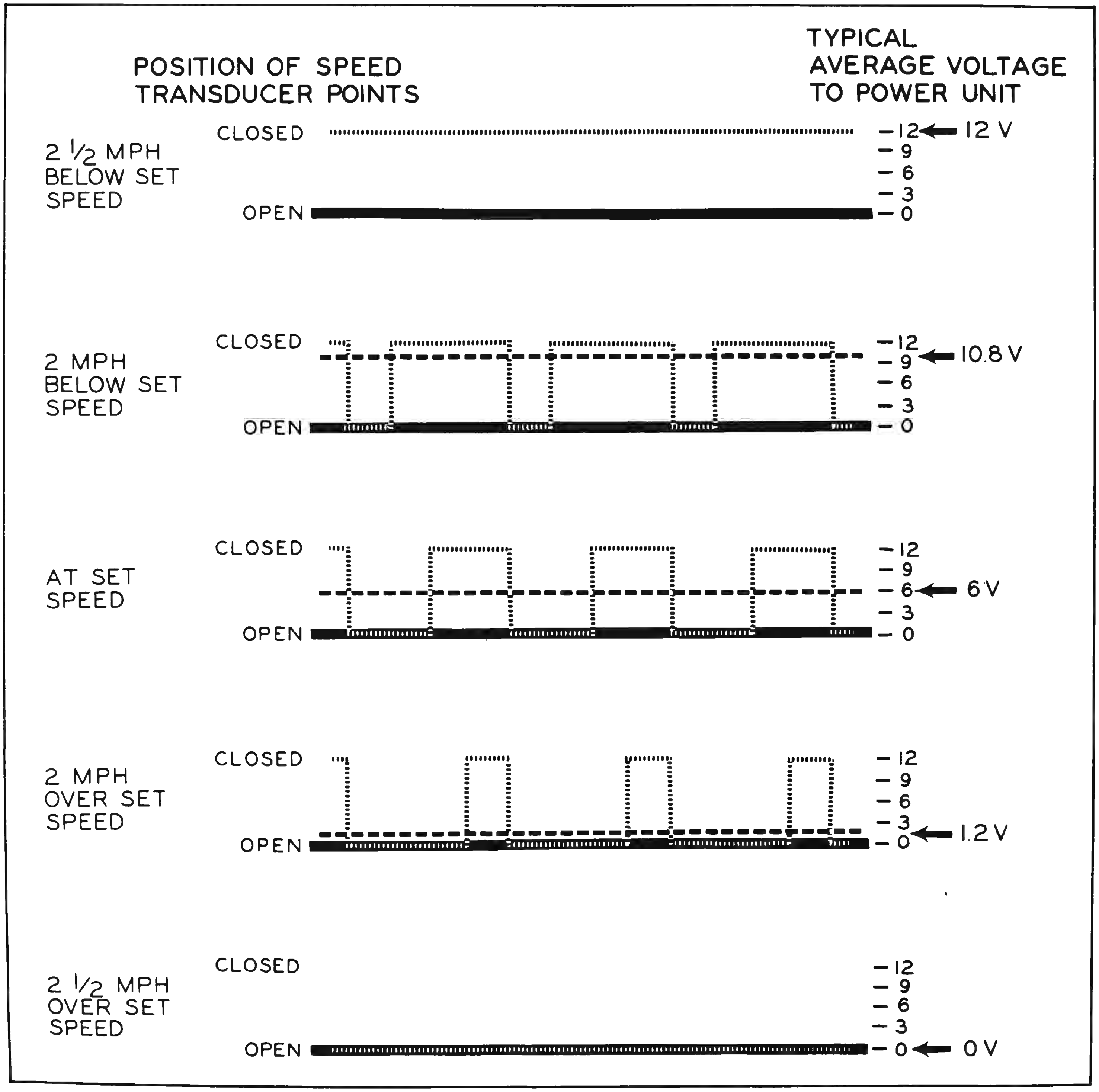


Figure 11-175—Speed Transducer Outputs

open for a greater interval of time during one complete oscillation. Whenever car speed is more than 2-1/2 MPH above the set speed, the circuit to the electronic control unit will be open during the entire oscillation.

As car speed decreases within 2-1/2 MPH below the set speed, the pickup arm moves away from the contact spring to allow the circuit to the electronic control unit to remain closed for a greater interval of time during one complete oscillation. Whenever car is less than 2-1/2 MPH below set speed, the circuit to the electronic control unit will be closed during the entire oscillation. Thus, the electrical signal which is reflected to the electronic control unit is proportional to the interval of time during which the contacts are open or closed which, in turn, is proportional to the amount the speedometer pointer is above or below the set speed.

3. AMPLIFIER AND RELAY - The electronic control unit consists of a relay assembly and a transistor amplifier assembly mounted on a common junction block which is an integral part of the system's wiring harness. Both assemblies are designed to individually plug into the junction block; therefore, each can be service separately. A two ampere fuse is incorporated into the junction block to protect the entire electrical circuitry of the system. In addition, the system is protected by the "BK" and "BZ" fuse located in the main fuse block. See figure 11-176.

The transistor amplifier serves as a power amplifier to increase the strength of the electrical signal from the speed transducer to a value capable of operating the power unit control valve. Since full current flow is not carried by the speed transducer contacts, their life is greatly increased. Design of the amplifier circuit is such that whenever the speed transducer contacts are closed, the circuit through the amplifier is completed and the power unit coil is energized. Likewise, whenever the speed transducer contacts are open, the circuit through the amplifier is open and the power unit coil is not energized.

As long as the holding coil remains energized to hold the contact points in the Down position, the system will be "locked" in cruise operation and car speed will be controlled by the power unit in accord with the electrical signal produced by the speed transducer. Opening either the ignition switch, the brake release switch or the engagement switch will "unlock" the system from cruise operation by allowing the relay contact points to return to the "up" position.

Two opposing coils and a double set of contact points within the relay assembly function to control the "locking" and "unlocking" of the system in cruise operation. In addition, the relay controls the operation of the CRUISE lamp. See figure 11-176.

Normally the contact points are held in the "up" position by spring tension. Whenever car speed is below set speed and the engagement switch is fully depressed, the holding coil is enenergized and since the speed transducer contact points are closed, the amplifier circuit is closed allowing the inhibiting coil and power unit coil to be energized. Since the magnetic attraction of the inhibiting coil opposes the attraction of the holding coil, the relay contact points will remain in the "up" position allowing the circuit to the power unit coil to be closed only continually depressing the engagement switch. With the relay contact points in the "up" position, the CRUISE lamp circuit is open indicating the system is not "locked" in cruise operation.

When car speed is within 2-1/2 MPH of the set speed or above, the amplifier circuit is opened by opening of the speed transducer contact points, and the inhibiting coil circuit will be opened allowing the holding coil to move the contact points to the down position. The CRUISE lamp circuit will then be completed indicating the system is "locked" in cruise operation and the inhibiting coil circuit will be opened to prevent energizing of the coil when the amplifier circuit is once again completed. In addition, a second supply circuit from the engagement switch will be completed enabling the system to function after the switch has been released to the Neutral or Cruise position.

4. ENGAGEMENT SWITCH - The engagement switch is a three-position switch connected in series with system circuitry. In the first, or "off" position, the circuit through the switch is open and the system is completely disengaged. In the Neutral or Cruise position, the circuit through the switch to the relay is closed and, providing the relay contacts are in the Down position, the system is energized. In the third, or Engage position, the switch to relay circuit is completed as well as a by-pass circuit which, when the relay contact points are in the Up position, initially energizes the system.

5. BRAKE RELEASE SWITCH - The brake release switch is an electric-pneumatic switch actuated by movement of the brake pedal arm. Since the switch is connected electrically in series with the system supply circuit, it will fully disengage and "unlock" the system from cruise operation when the switch is opened. Opening of the switch requires a mazimum of 1/4" brake pedal travel. Additional pedal travel will open

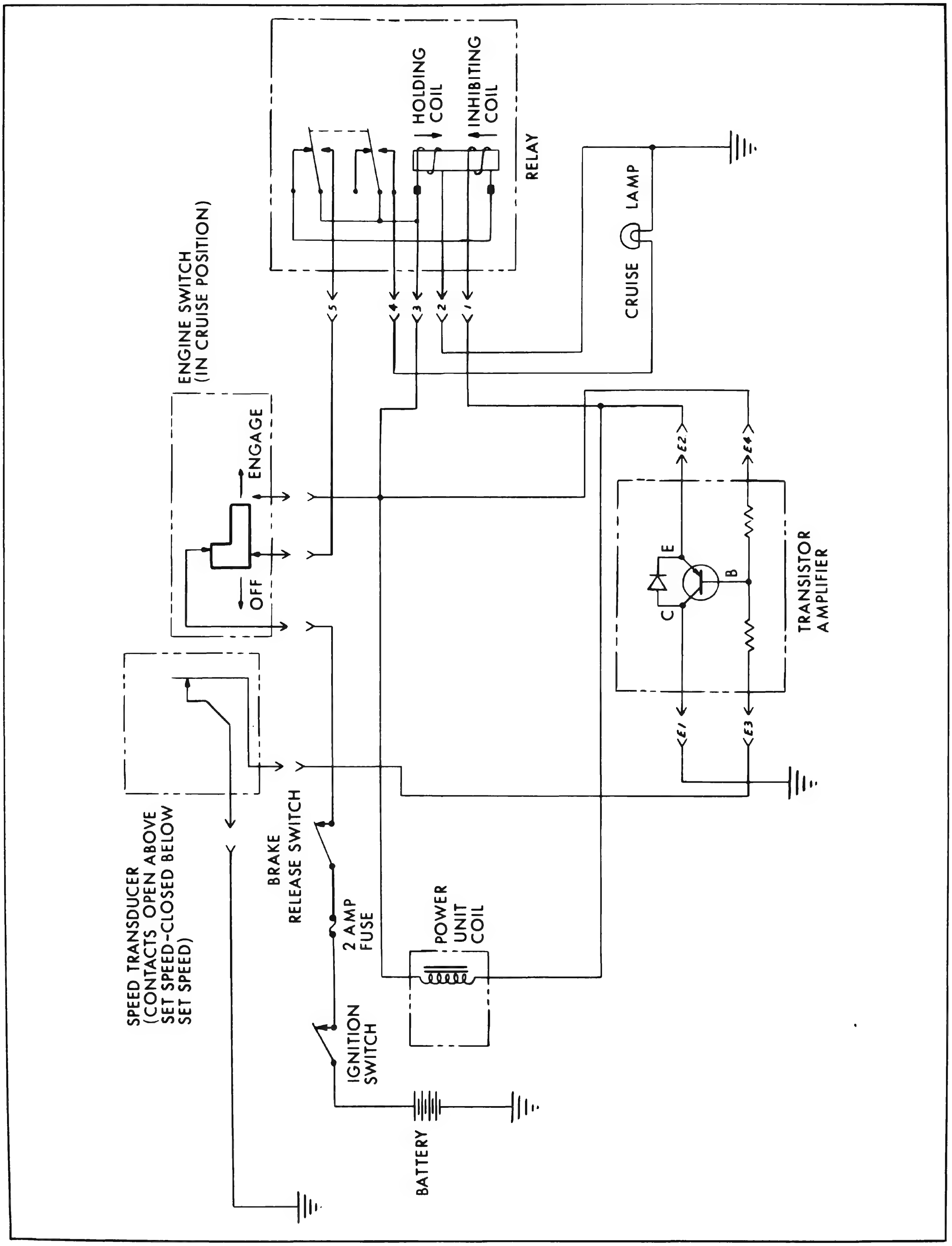


Figure 11-176—Electro-Cruise Wiring Diagram

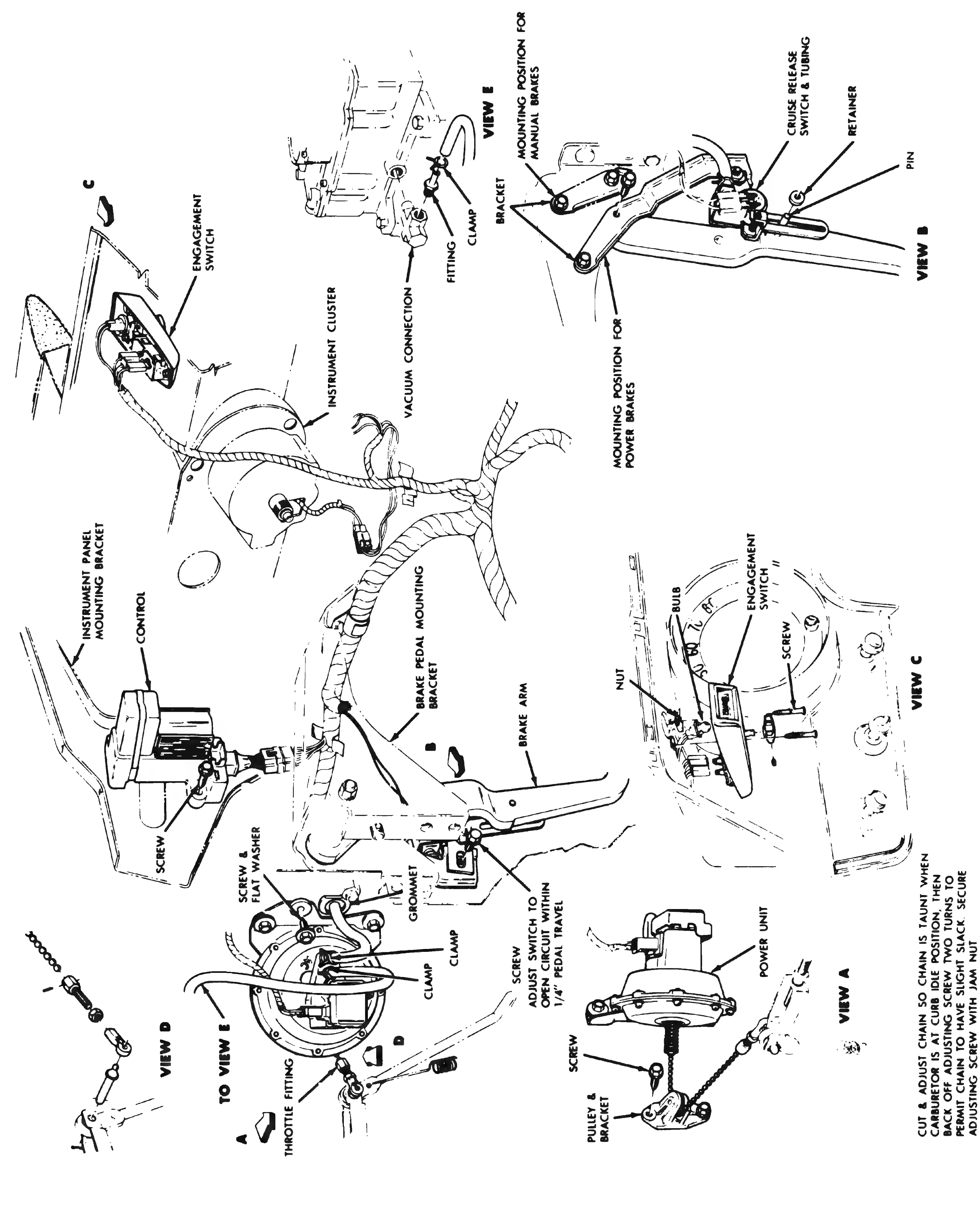


Figure 11-177—Electro-Cruise Installation - 4400, 4600 and 4800 Series

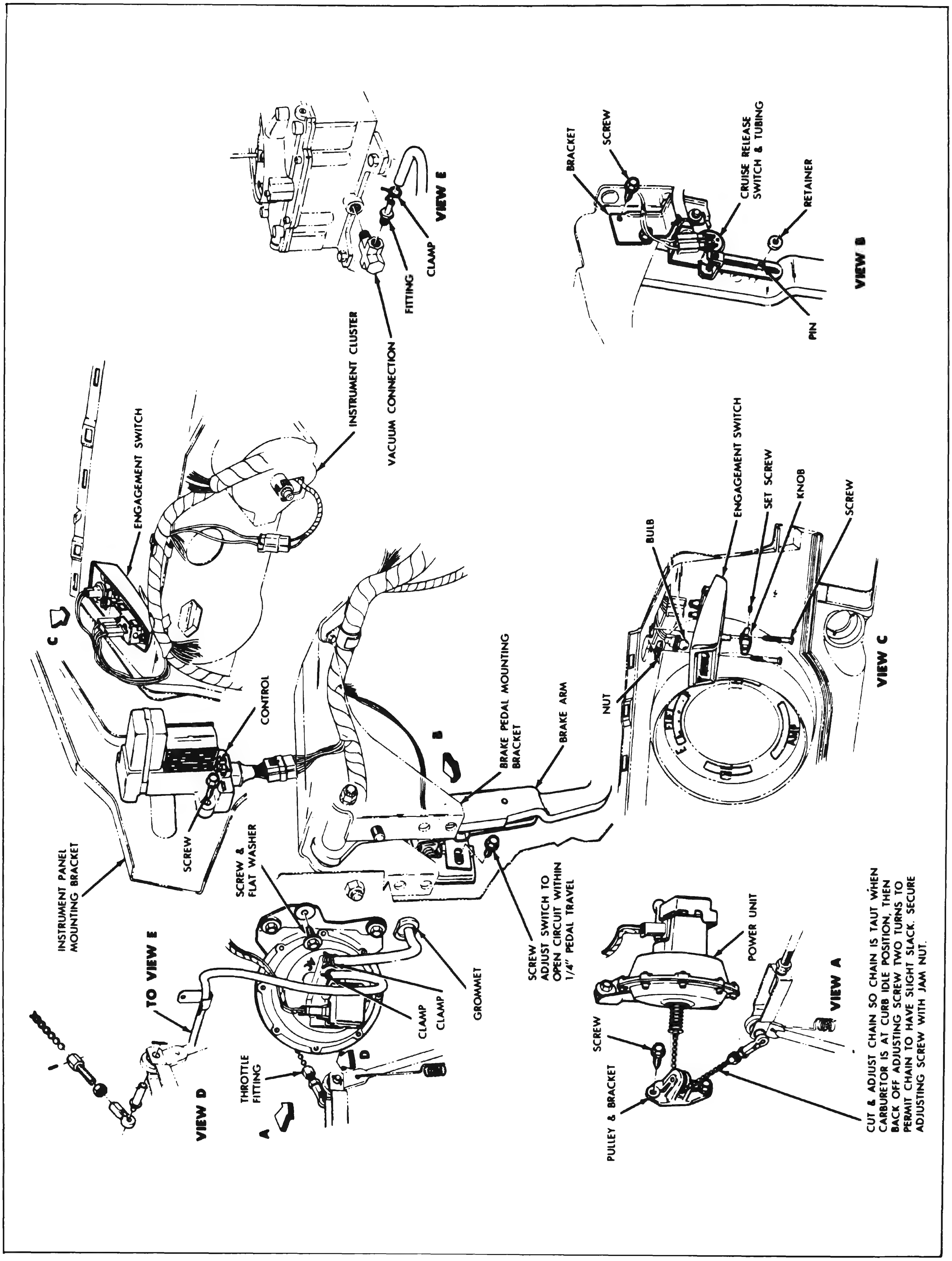


Figure 11-178—Electro-Cruise Installation - 4700 Series

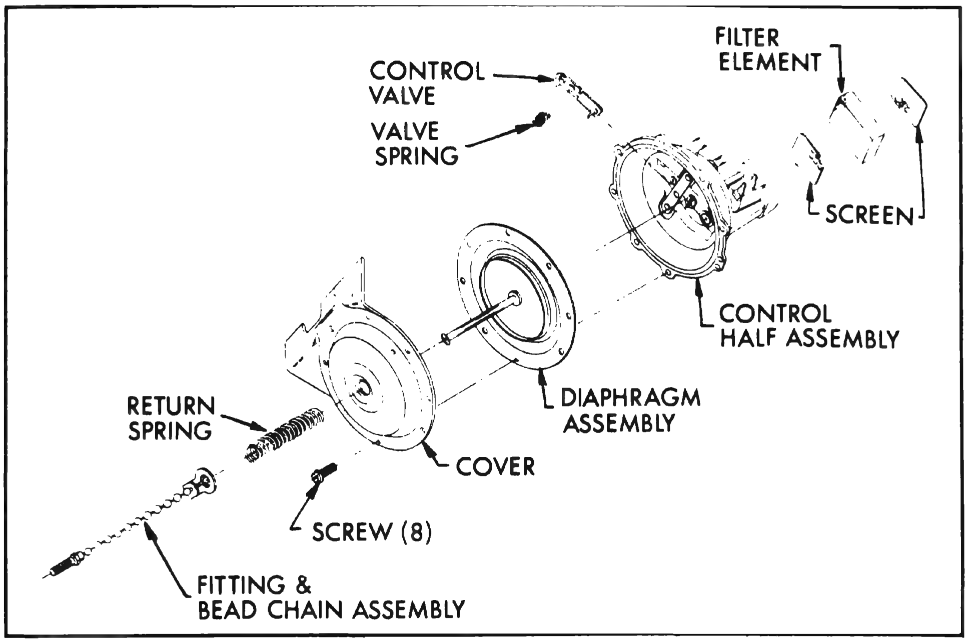


Figure 11-179—Exploded View of Power Unit

a "flap" type valve to vent the power unit diaphragm chamber to atmosphere assuring positive release of the power unit.

11-23 ELECTRO-CRUISE SERVICE PROCEDURES

IMPORTANT: Do not lubricate the power unit bead chain or its pulley.

The only maintenance required on the Electro-Cruise is the cleaning of the power unit air filter. The recommendations and procedure for cleaning of the filter are listed in paragraph 1-3.

a. Power Unit Bead Chain Adjustment

1. Disconnect bead chain adapter assembly from clevis pin by snapping it free from clevis pin. See figures 11-177 and 11-178.

2. Adjust engine hot idle speed to recommended setting, and then shut off engine.

3. Reattach bead chain to clevis pin and position carburetor fast idle cam ot "hot" idle position.

4. Check bead chain to insure that there is a slight amount of slack in chain.

NOTE: If chain is too loose or too tight, loosen jam nut on threaded stud of throttle lever adapter assembly, and rotate stud until chain is just taut. Then back off threaded stud two full turns.

b. Brake Release Switch Adjustment

1. Disconnect wiring harness connector from brake release switch, and connect an ohmmeter or test lamp (J-21005) across switch terminals.

NOTE: If desired, the cruise lamp of the engagement switch may be used as a test lamp by unplugging speed transducer connector at speedometer, and leaving brake release switch wiring connector on switch. Then turn ignition switch on and press lever of engagement switch to activate cruise control lamp. The brake pedal must be in the released position (rearward) for the electro-cruise to operate.

2. Loosen the screw that retains brake release switch to brake pedal support bracket. Position the switch to open the circuit within 1/4 inch brake pedal travel.

NOTE: An open circuit will be indicated by an unlit test lamp or indefinite reading on ohmmeter. If cruise lamp is used, an open circuit will be indicated when light goes out.

3. Tighten adjusting screw and recheck adjustment of brake release switch.

c. Disassembly and Assembly of Power Unit

1. Disconnect the bead adapter chain attached to the clevis pin by snapping it free from clevis pin. See figures 11-177 and 11-178.

2. Remove the wire harness connector from the power unit coil.

3. Remove engine vacuum and brake release switch lines from power unit.

4. Remove screws holding the power unit assembly to the cowl.

5. Depress the diaphragm return spring and remove bead chain by turning fitting 90° and slipping off shaft. See figure 11-179.

6. Remove the eight 10-32 cap head screws holding the power unit to its mounting bracket.

7. Remove the control valve return spring by depressing with a knife blade and pushing sideways.

8. Remove control valve.

9. Remove air filter from unit.

10. Wash power unit in a good detergent.

11. Examine diaphragm for cracks and pin holes and replace if necessary.

12. Check control valve pads and its sealing surface for dirt, chips and burrs.

13. Clean or replace air filter as required.

14. Check for obstructions in air and vacuum orfices.

15. Reassemble by reversing disassembly prodecure. Care should be taken when the light cap screws are placed back on the mounting bracket to tighten opposite sets of screws at a time and repeat this procedure until they are all tight.

16. After power unit is reinstalled, adjust bead chain (subpar. "a") and leak test unit (par. 11-24 subpar. "a").

11-24 ELECTRO-CRUISE TROUBLE DIAGNOSIS

Whenever a specific complaint is encountered with the Electro-Cruise system, the Trouble Diagnosis Chart should be used for reference as to the complaint and its possible cause. Whenever a general complaint is encountered, the Trouble Diagnosis Test Procedure Chart (figure 11-183) should be used to determine the area of malfunction. Since the procedures outlined in this chart are performed with the car stationary, it may be necessary, in some cases, to road test the system to determine the specific complaint.

All electrical and vacuum connections and other obvious items, such as the bead chain adjustment and brake release switch adjustment, should be checked and corrected prior to any type of testing.

a. Vacuum, Air Leak and Power Unit Test

1. Disconnect power unit bead chain from throttle rod bracket threaded stud.

IMPORTANT: Check all vacuum hoses for proper attachment at vacuum source, power unit and brake release switch. See figures 11-177 and 11-178.

2. Pull Electro-Cruise engage lever to the off position.

3. Note position of power unit diaphragm pull rod.

4. Start engine and again note position of power unit diaphragm rod. Movement normally indicates leakage through the vacuum orifice and control valve. If maximum movement is noted, the wiring harness connector should be temporarily disconnected from the power unit to eliminate the possibility of an electrical problem. If diaphragm rod still moves into power unit disassembly, inspection and repair of the power unit will be required. Paragraph 11-23, subparagraph "c".

5. With engine still running and bead chain still disconnected, push cruise engagement lever forward and hold. If power unit diaphragm rod moves into unit, proceed with Step 6. If rod does not move into unit, remove wiring connector from power unit. Using jumper wires, ground one terminal of unit and connect the other terminal to a 12 volt source and again observe diaphragm rod with engine running. If unit does not operate, remove hose which goes to brake release switch and plug release hose fitting on power unit. If power unit still does not operate properly, it is defective and should be repaired.

6. With power unit diaphragm rod pulled all the way in unit by engine vacuum and engagement lever held forward, clamp off vacuum source hose. Leave hose clamped and engagement lever held forward for 90 seconds. Any outward movement of rod in this period indicates leakage in the hose con nections, in the brake release switch, in the power unit diaphragm or through the power unit air orifice and control valve.

7. If leakage is noted, remove hose from the brake switch release hose fitting at the power unit, plug the release hose fitting and repeat Steps 5 and 6. If diaphragm rod now remains stationary for 90 seconds, leakage is indicated in the brake release switch or hose to it. If diaphragm rod still moves outward and all hose connections and conditions of hoses are okay, the power unit has an internal leak and should be repaired.

b. Relay Tests

If through trouble diagnosis, trouble is indicated with the Electro-Cruise relay, the relay can be checked by two methods.

1. The first method or procedure is to substitute a known good relay and perform the procedure outlined in the Trouble Diagnosis Test Procedure chart or road test the car to determine whether or not the condition has been corrected.

2. The second method is to remove the relay and perform the Non-Pull-In and Pull-In checks as outlined below. These checks involve the use of a 12 volt battery, jumper wires and a 12 volt lamp such as a #57 lamp to check operation and continuity of the relay and will conclusively indicate a defective unit. A unit found to be defective will require replacement.

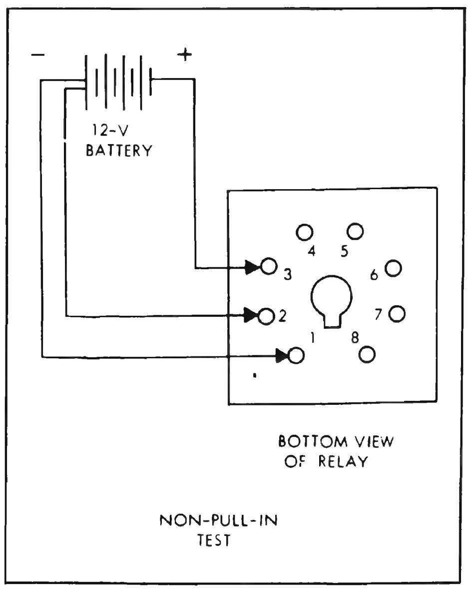


Figure 11-180—Relay Non-Pull-In Check

(a) Non-Pull-In Check

(1) Connect pins 1 and 2 to the negative terminal of a 12 volt battery. See figure 11-181.

(2) Connect pin 3 to the positive terminal of the battery

3. When the connection to pin 3 is made, the relay should not pull in. A checking sound will be noted if the relay pulls in and indicates the relay is defective and must be replaced.

(4) Perform Pull-In check.

(b) Pull-In Check.

(1) Connect pins 1 and 2 to the negative terminal of a 12 volt battery. See figure 11-180.

(2) Connect pin 3 to the positive terminal of the battery.

(3) Connect a 12 volt test lamp such as a #57 lamp between the negative terminal of the battery and the relay, alternating the connection between pin 4 and 5.

(4) During either of the above connections, the lamp must not light. If lamp lights, a defective relay is indicated and must be replaced.

(5) Disconnect connection to pin 1 and again alternate the test lamp lead between pin 4 and 5.

(6) During either of the above connections the lamp should light. Failure of the lamp to light indicates a defective relay and must be replaced.

c. Amplifier Test

The amplifier can be checked using one of two methods similar to checking the relay.

1. The first method is to substitute a known good amplifier and perform the procedure outlined in the Trouble Diagnosis Test Procedure chart, Figure 11-183 or road test the car to determine whether or not the condition has been corrected.

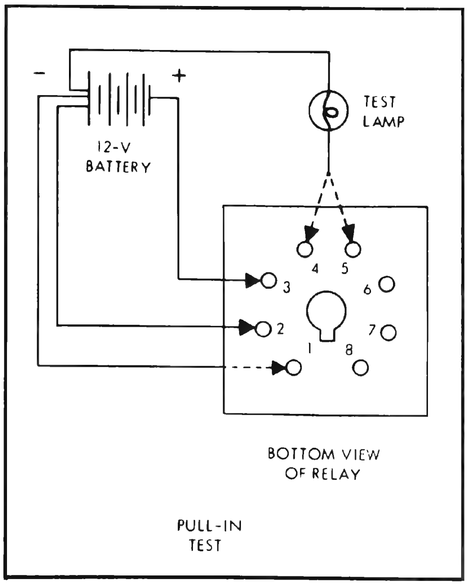


Figure 11-181—Relay Pull-In Check

2. The second method is to remove the amplifier and perform check as outlined below. This check involves the use of a 12 volt test lamp to check operation and continuity of the amplifier and will conclusively indicate a defective unit.

(a) Connect terminal E_1 to the negative terminal of the 12 volt battery. See Figure 11-182.

(b) Connect a 12 volt test lamp such as a #57 lamp between the terminal E_2 and the positive terminal of the battery.

(c) Connect terminal E_4 to the positive terminal of the battery.

(d) Momentarily connect terminal E_3 to the ground terminal of the battery and observe test lamp.

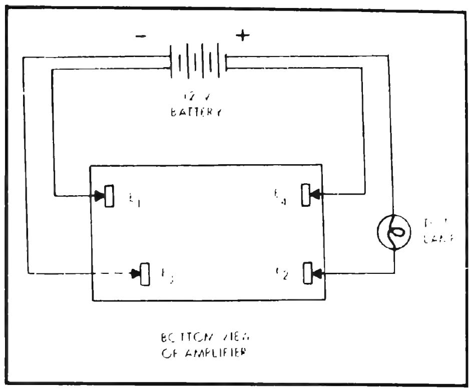


Figure 11-182—Amplifier Test

(e) The test lamp should light when terminal E_3 is connected to the ground terminal of the battery and should go out when the terminal is disconnected. If lamp remains lit when terminal E_3 is disconnected, or the lamp does not light when terminal E_3 is connected, the amplifier is defective and must be replaced.

d. Speedometer Testing

Speedometer testing is difficult since conclusive tests can only be performed with the unit in operation. Generally, then, the speedometer is assumed to be in satisfactory condition until all other components have been checked and found to be in satisfactory condition. If, after testing other components, wire harness continuity, electrical connections and vacuum leakage are found to be satisfactory, the speedometer should be removed and serviced by an authorized repair station.

e. Continuity Tests

Continuity of the entire Electro-Cruise electrical system can be checked using the wiring diaphragm in Figure 11-176.

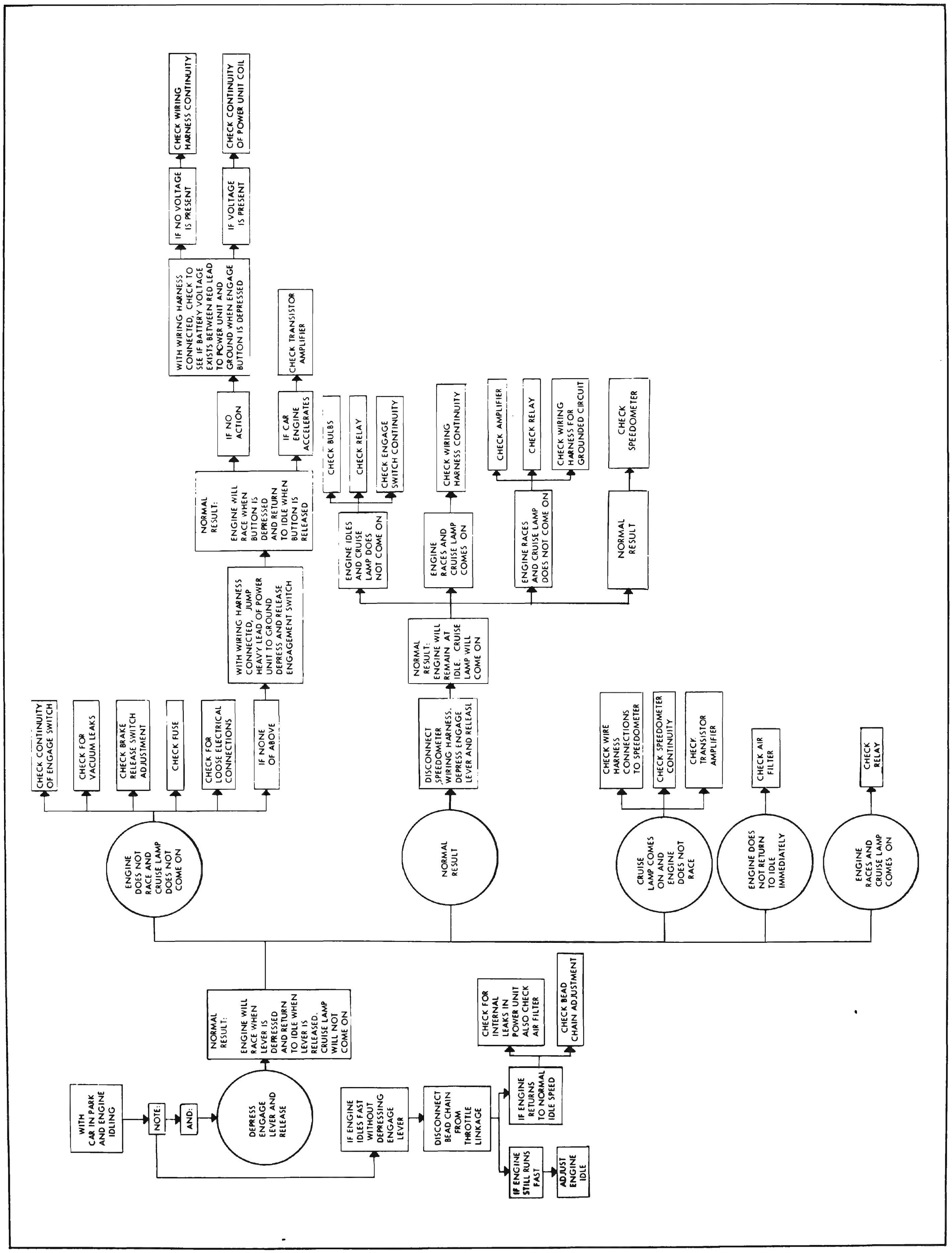


Figure 11-183—Electro-Cruise Trouble Diagnosis Test Procedure Chart

Electro-Cruise Trouble Diagnosis Chart

COMPLAINT	POSSIBLE CAUSE
A. No action when lever is pushed.	1. Disconnected electrical connections or open in wiring. 2. Blown fuses. 3. Brake release switch adjustment. 4. Vacuum leakage. 5. Power unit coil open. 6. Defective transistor amplifier.
B. CRUISE lamp comes on when lever is pushed and no car response.	1. Harness to speedometer unplugged or loose. 2. Defective speed transducer. 3. Defective transistor amplifier. 4. Defective relay.
C. ELECTRO-CRUISE remains engaged when brake is touched.	1. Brake release switch adjustment. 2. Shorted brake release switch. 3. Shorted wire harness.
D. Blow fuses.	1. Shorted wiring. 2. Shorted relay, cruise lamp or power unit coil. 3. Shorted transistor amplifier.
E. Engine races as soon as car is started when engage lever is not pushed.	1. Shorted wire harness. 2. Shorted engage switch. 3. Shorted relay. 4. Vacuum orifice leak in power unit. 5. Stuck accelerator linkage.
F. ELECTRO-CRUISE will not lock in after set speed is attained.	1. Defective relay. 2. Defective engage switch.
G. Car keeps accelerating up past set speed.	1. Shorted wire harness. 2. Shorted speedometer. 3. Defective relay. 4. Defective transistor amplifier.
H. Automatically locks in CRUISE when car goes over bumps.	1. Defective relay.
I. Drops out of CRUISE control when over bumps.	1. Defective relay. 2. Loose electrical connections. 3. Brake release switch adjustment.

COMPLAINT	POSSIBLE CAUSE
J. Erratic cruise speed.	1. Loose electrical connections. 2. Defective speedometer. 3. Defective power unit. 4. Vacuum leakage.
K. Slow response.	1. Vacuum leakage.
L. Hunts at slow speed.	1. Defective speedometer. 2. Bead chain adjustment. 3. Stiff accelerator linkage. 4. Vacuum leakage. 5. Dragging brakes.
M. Does not disengage when engage lever is pulled out.	1. Shorted wire harness. 2. Shorted engage switch. 3. Defective relay.
N. CRUISE lamp does not light.	1. Burned out lamp bulb. 2. Defective relay. 3. Disconnected electrical connections or broken wiring.
O. Engine will not idle at slow speed when ELECTRO-CRUISE is not engaged.	1. Vacuum leakage. 2. Bead chain adjustment.
P. Speed setting pointer and speedometer needle do not coincide speed when in cruise.	1. Stiff throttle linkage. 2. Vacuum leakage. 3. Speedometer out of calibration. 4. Kinked speedometer cable.

SECTION 11-F
TACHOMETER, FOUR NOTE HORN, VACUUM TRUNK RELEASE REAR WINDOW DEFROSTER INSTALLATIONS AND REMOTE CONTROL OUTSIDE MIRROR

CONTENTS OF SECTION 11-F

11-25 SERVICING ACCESSORIES

The following accessories pictured herein are provided as optional equipment on the 1964 Buick 4400, 4600, 4700 and 4800 Series cars. The servicing, such as removal and installation of the accessory components will be obvious when viewing the installation illustrations contained on the following pages.

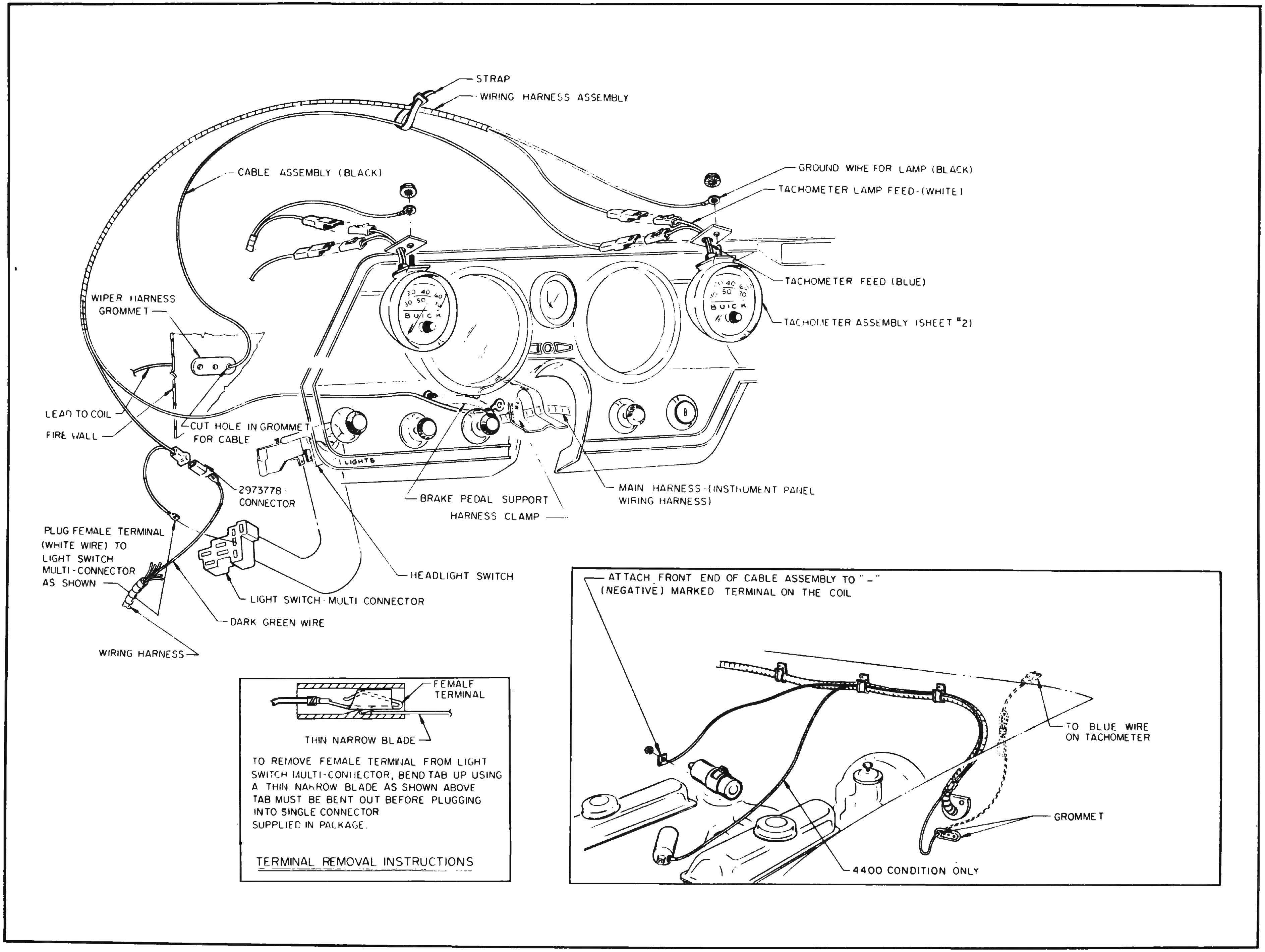


Figure 11-184—Tachometer Installation—4400, 4600 and 4800 Series

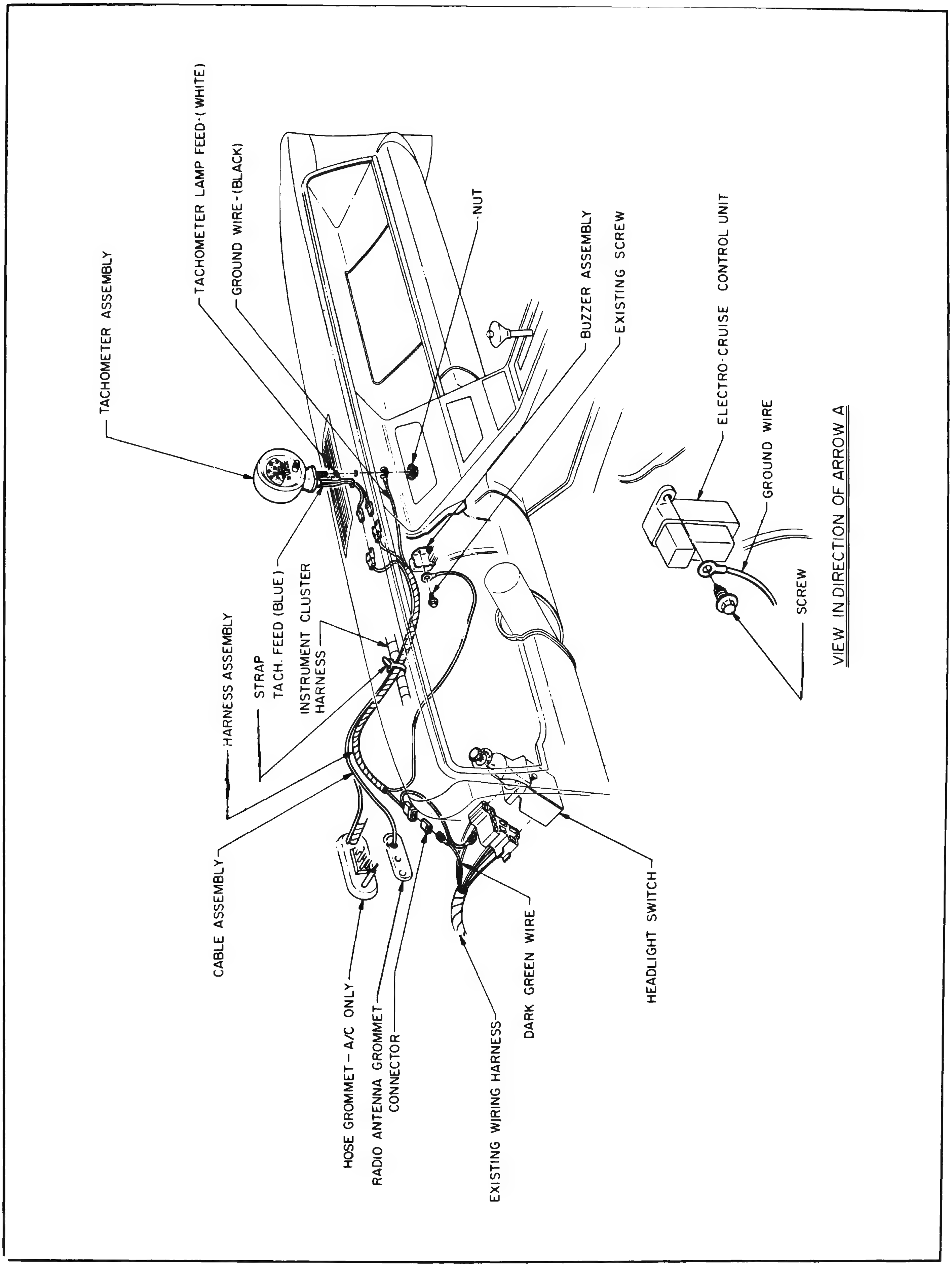


Figure 11-185—Tachometer Installation—4700 Series

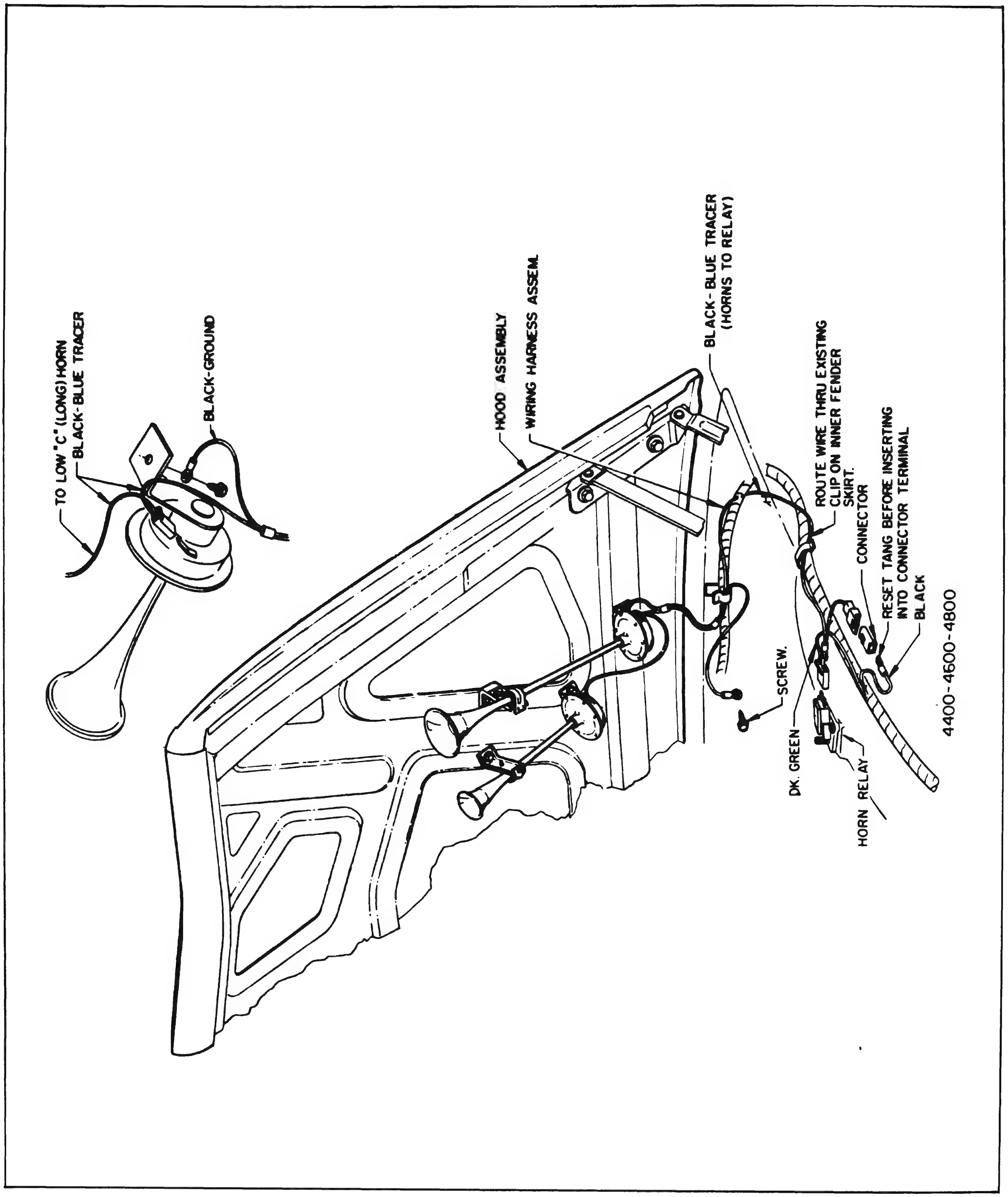


Figure 11-186—Four Note Horn Installation—4400, 4600 and 4800 Series

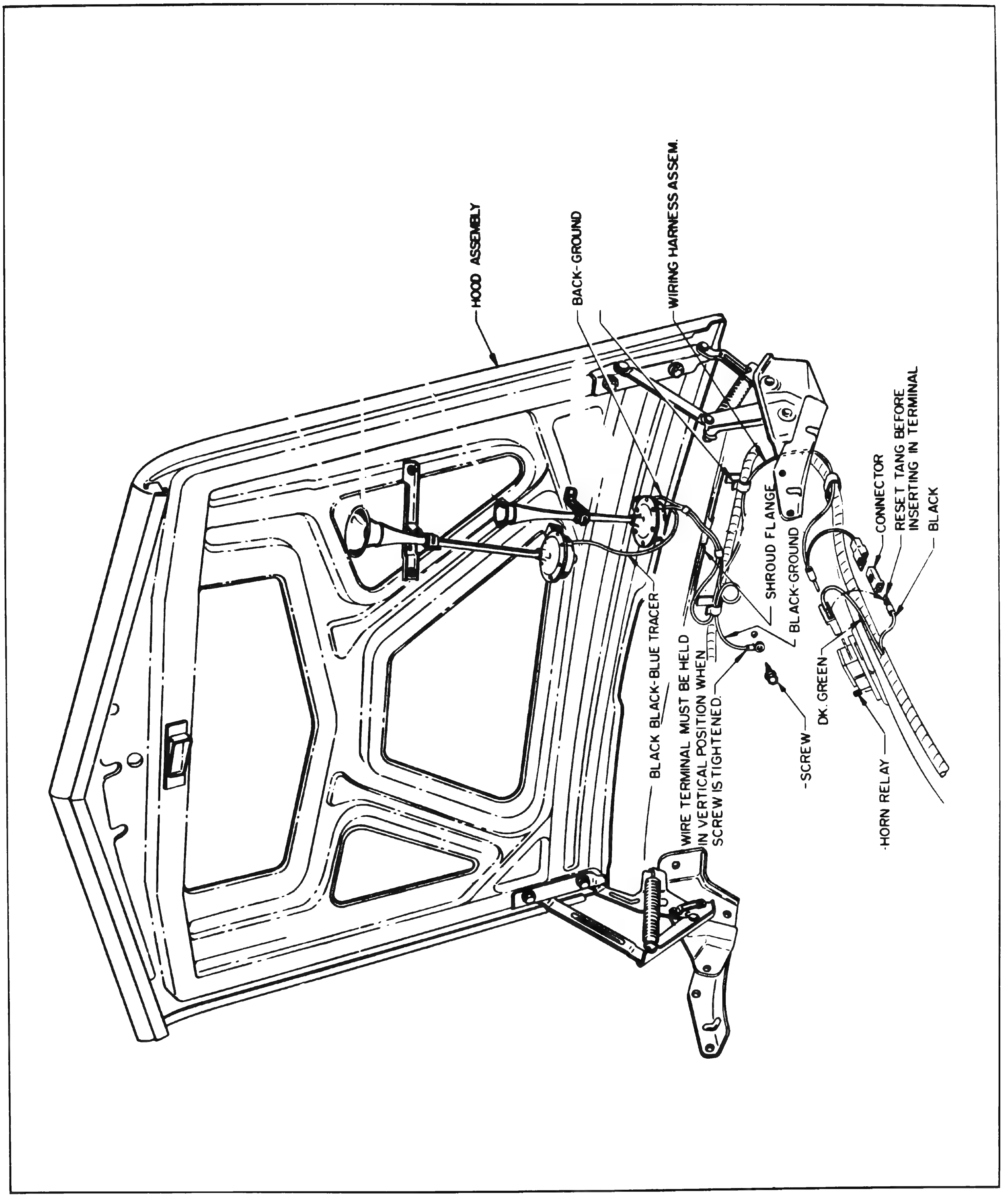


Figure 11-187—Four Note Horn Installation—4700 Series

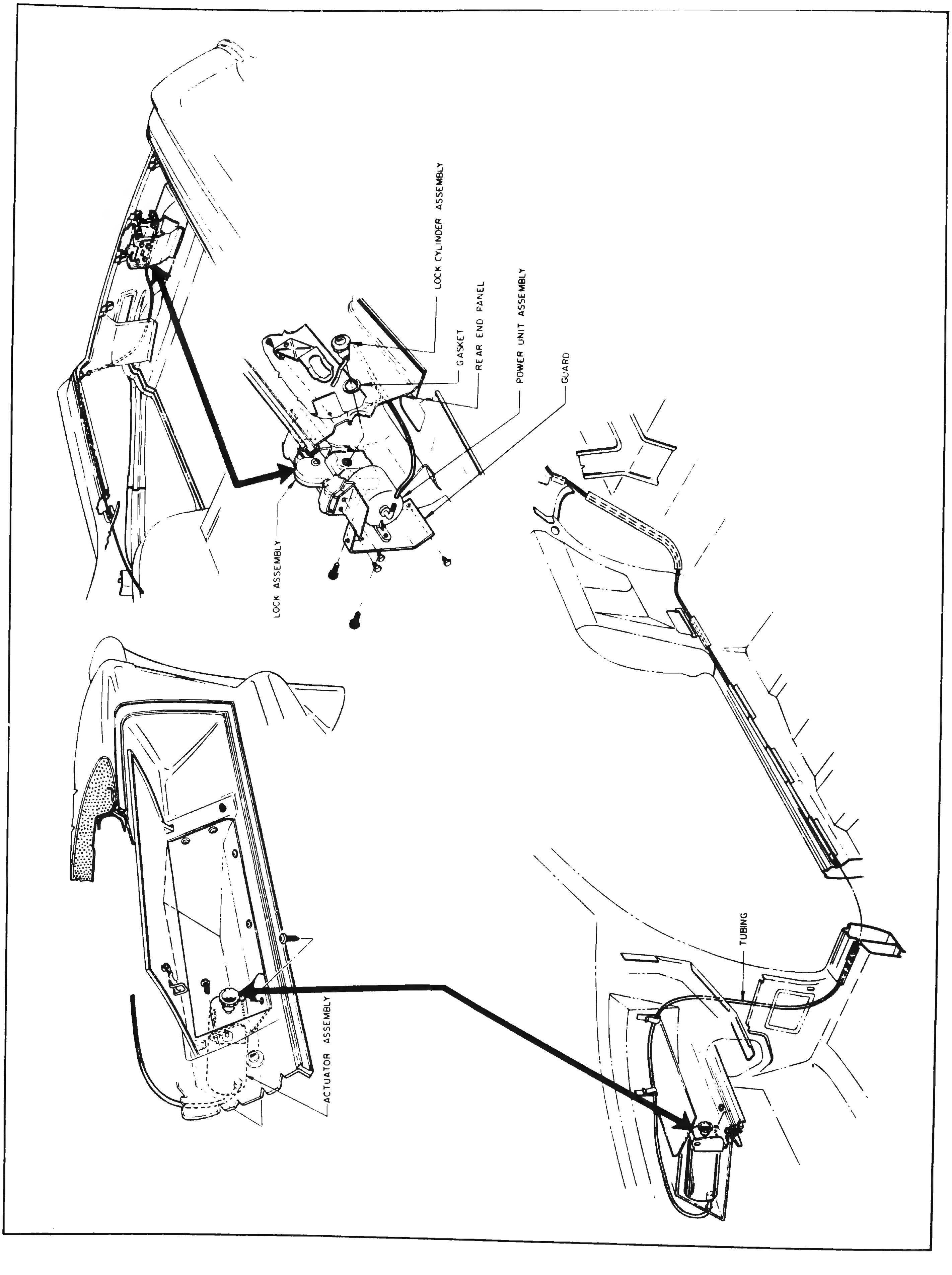


Figure 11-188—Vacuum Trunk Release Installation—4400, 4600, and 4800 Series

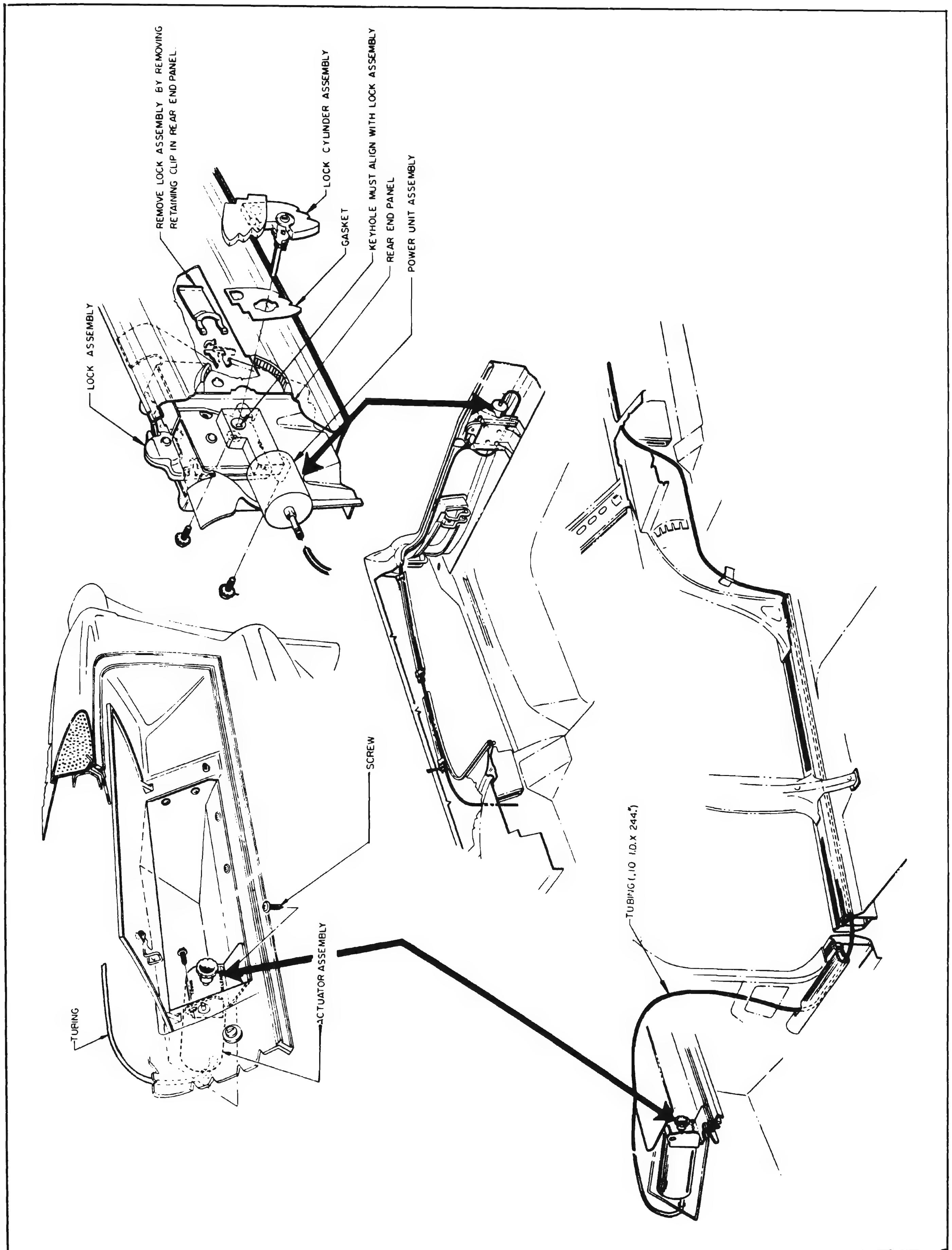


Figure 11-189—Vacuum Trunk Release Installation—4700 Series

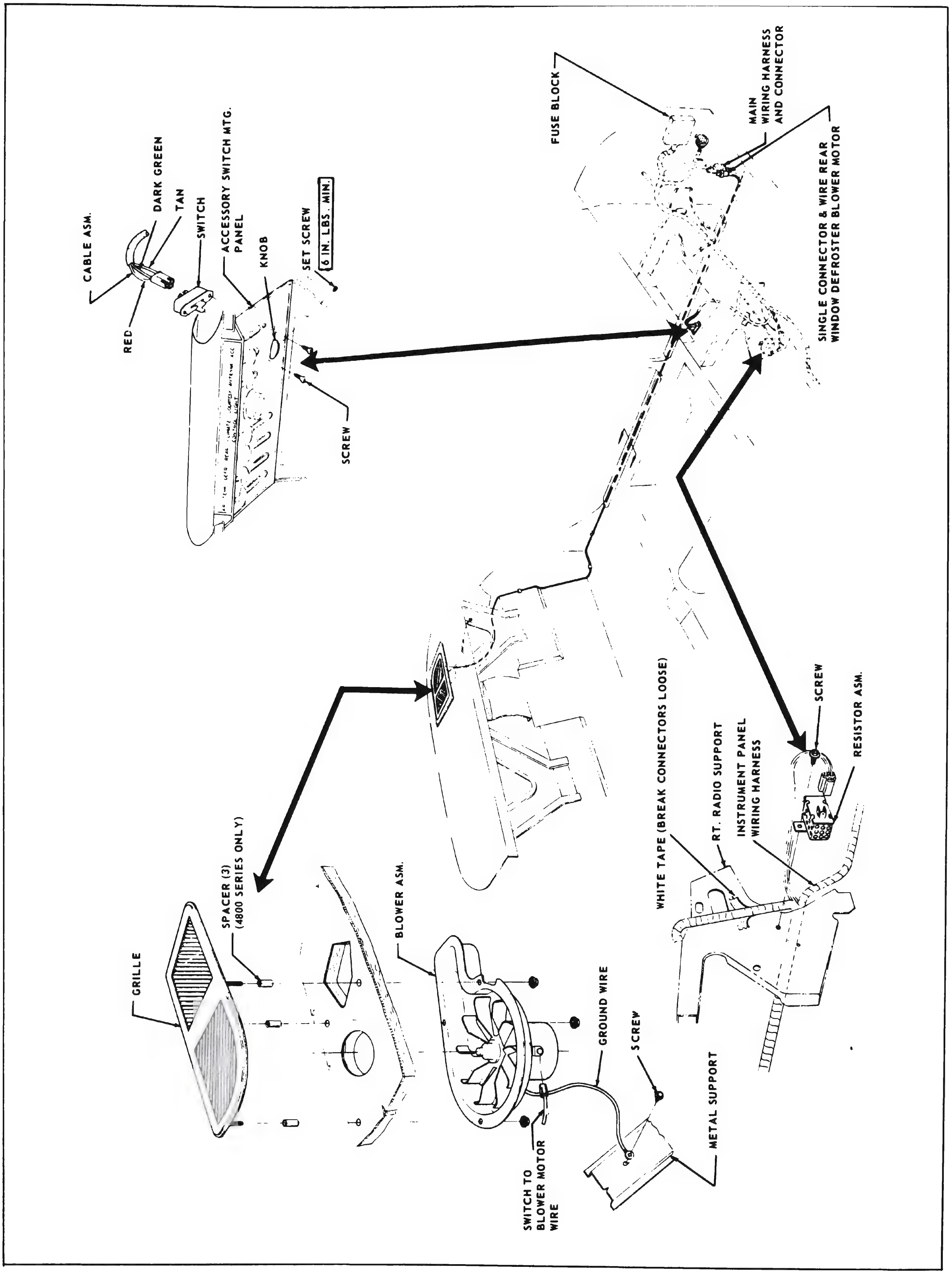


Figure 11-190—Rear Window Defroster Installation—4400, 4600 and 4800 Series

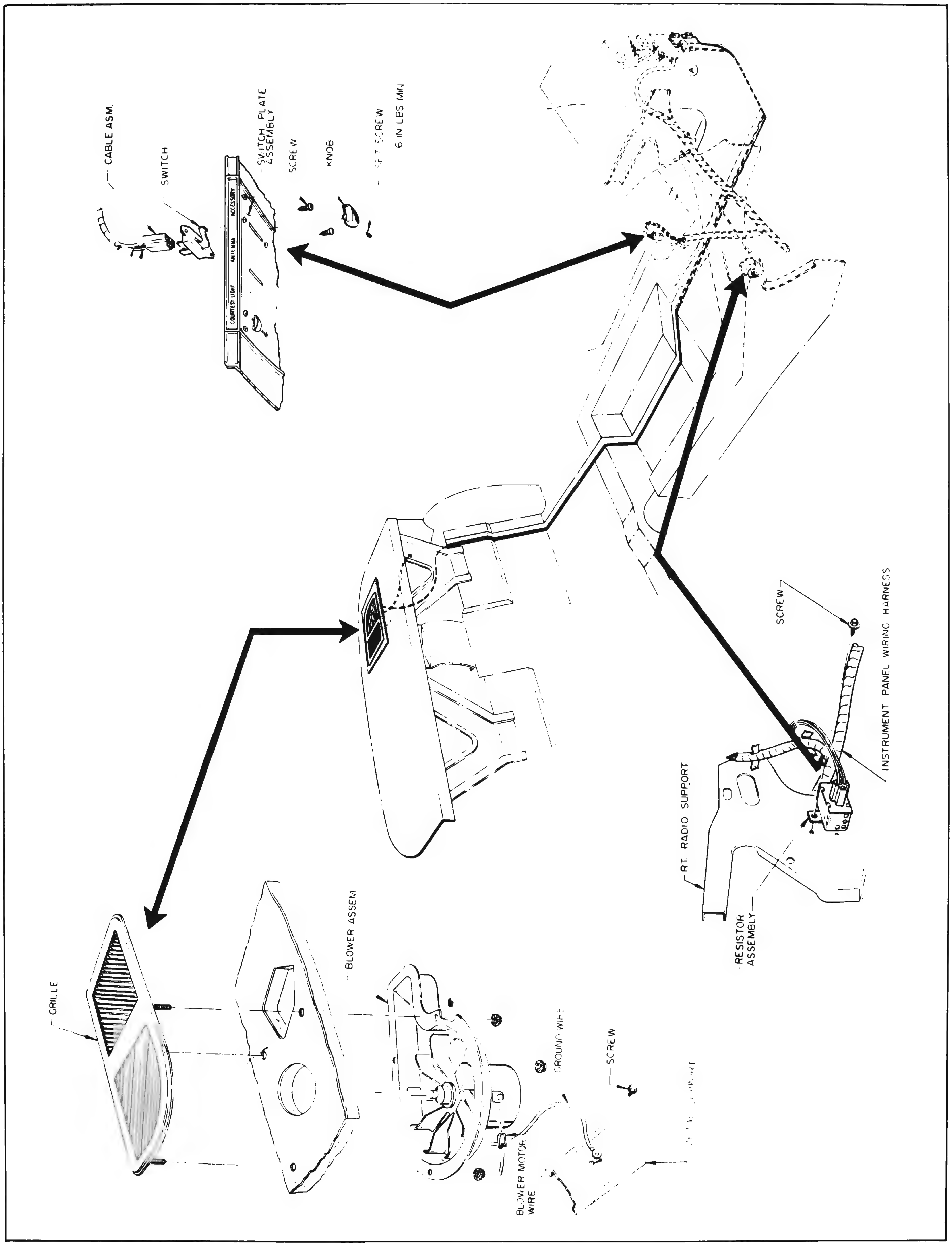


Figure 11-191—Rear Window Defroster Installation—4700 Series

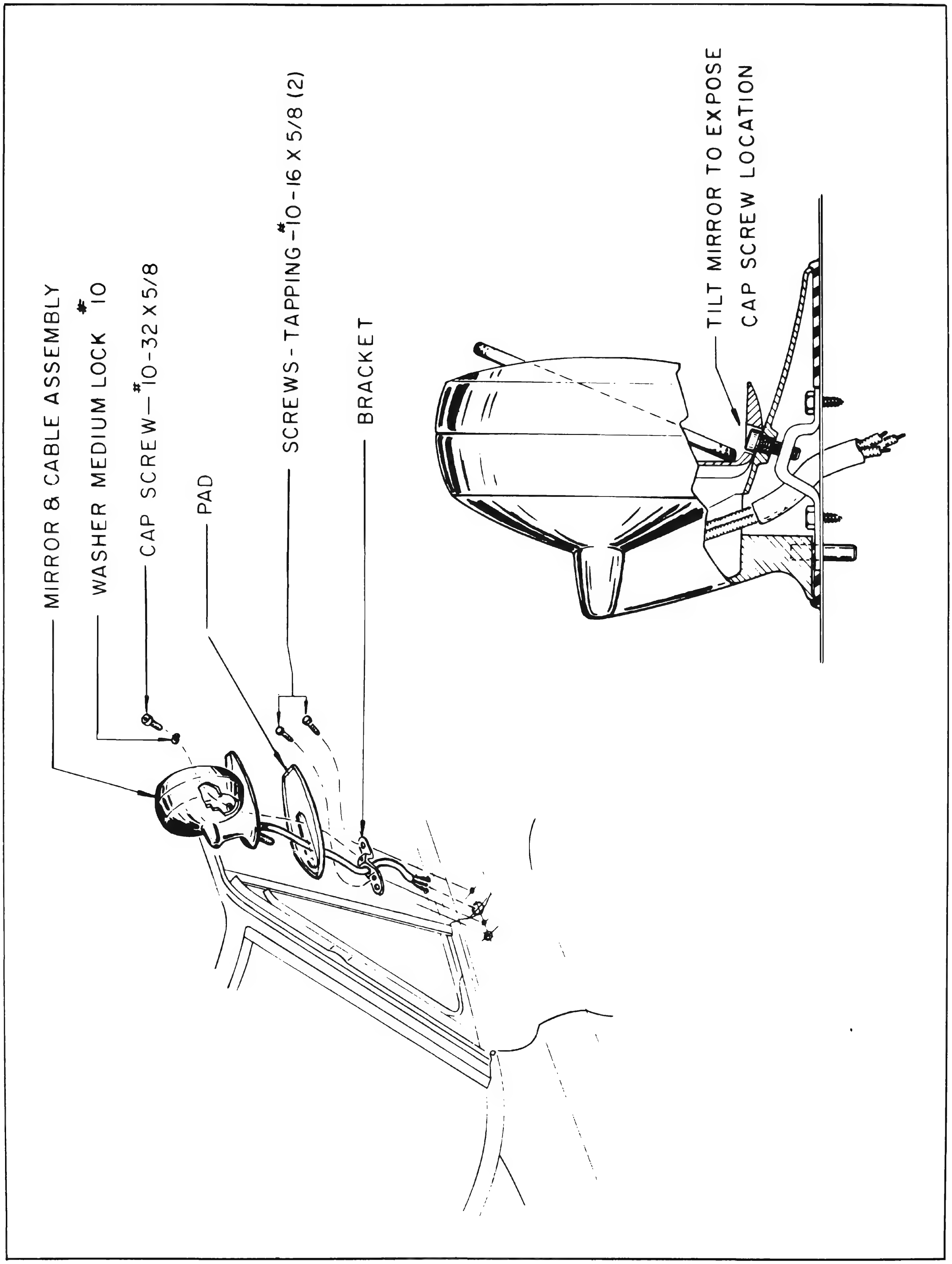


Figure 11-192—Remote Control Outside Mirror Installation—4400, 4600, 4700 and 4800 Series

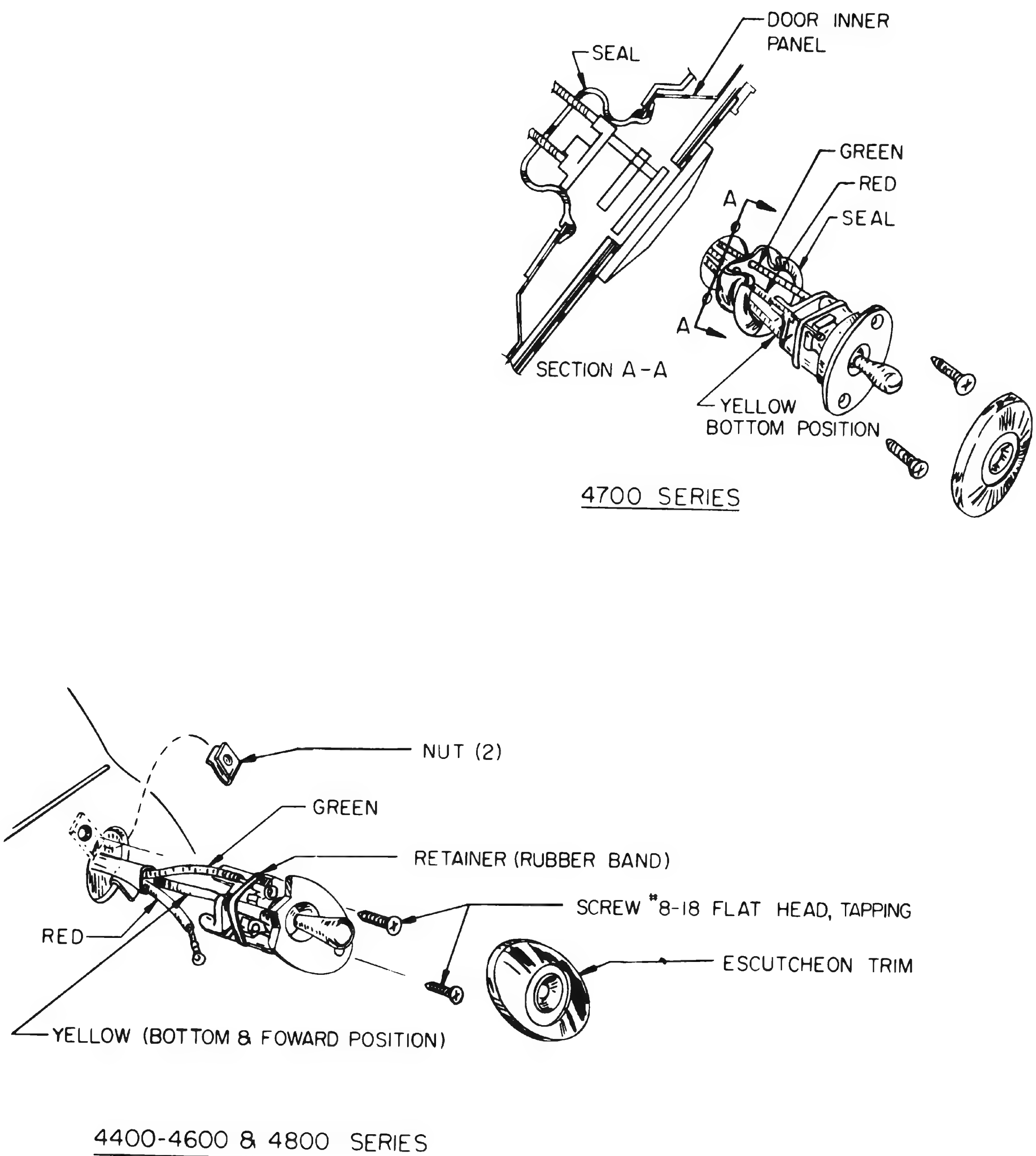


Figure 11-193—Remote Control Outside Mirror Installation—4400, 4600, 4700 and 4800 Series

GROUP 12

FRONT END SHEET METAL & BUMPERS

CONTENTS OF GROUP 12

12-1 DESCRIPTION OF FRONT END SHEET METAL

a. Front End Sheet Metal Assembly

The front end sheet metal assembly is attached to the frame and body at adjustment points. See Figures 12-1 and 12-2. The front of the assembly is supported by two mounts located at the frame side rails. Shims at these locations allow up and down movement of the front of the sheet metal assembly. Fore and aft and side adjustment is allowed by oversize holes in the inner skirt assembly. Special washers at the upper rear locations allow adjustment of the rear assembly. The lower rear edge of the assembly is attached to the body at the rocker panel by bolts on each side. Shims are used at this location to provide up and down adjustment at the rear of the fender.

IMPORTANT: The bolts that retain the sheet metal braces must be torqued to the required torques. If these bolts are loose, the braces will not provide additional support for the sheet metal assembly.

b. Hood, Hinges and Latch Mechanism

The hood panel is of one piece construction, strengthened and held to shape by a reinforcement of stamped sheet metal.

The rear of the hood assembly is attached to the body cowl and fender on each side by hinge assemblies which permit the front of the hood to be raised. A heavy coil spring connected between each hinge assembly assists in raising the hood and holds it in the open position. See Figures 12-3 and 12-4.

The front of the hood is held down by a ratchet type hood latch located on the upper tie bar. See Figures 12-9 and 10.

The hood is unlocked by lifting the latch handle located beneath the front center of the grille.

c. Radiator Mounting and Adjustment

The radiator is mounted in rubber, using a three-point mounting system of rubber-faced "U"-shaped brackets.

Two of the brackets are included in the lower support bracket assembly which attaches at each end of the frame. The third is located at the top center in the guard and bracket assembly which attaches to the upper tie bar. Fore and aft adjustment is provided by slotted holes in the bracket assembly.

Non air conditioning radiators are to be located 1-3/16" plus or minus 1/8" ahead of cooling fan and parallel within 1/4". The air conditioning radiator is to be located parallel to the fan, with the shroud paralled to the radiator core and the fan projecting out of shroud 3/4 of an inch.

12-2 FENDER, BUMPER AND HOOD ALIGNMENT INSPECTION

The hood, front fenders and bumpers must be aligned with each other on every car to take care of slight variations in form and dimensions of the individual parts. Sheet metal parts stamped in a given set of dies will vary somewhat in form and dimensions due to variations in the hardness of different batches of sheet metal, which cause the stampings to spring in varying amounts when released from the form dies.

The hood and front fenders are properly aligned during the installation at the factory; however, some readjustments may be required after a car has been shipped or has been in service for some time. This is because sheet metal parts may take a different "set" as a result of vibration and shock incident to shipping or operation during the break-in period. In judging the need for readjustment it must be understood that exactly uniform fit and spacing cannot be obtained on all cars of a given model.

a. Hood Noises or Panel Flutter

Squeaks or grunting noises in the hood when driving over rough roads do not necessarily indicate misalignment of hood and fenders. These noises may be caused by metal contact at some point where clearance should exist or when head bumpers are worn or dry.

If the hood squeaks, check with 1/16" thick feeler all around the hood for clearance at the fenders and cowl. If an edge of metal is making contact at any point where clearance should exist a bright metal spot will usually be found. Such spots can be depressed by spring hammering to provide clearance.

A grunting noise in the hood is usually caused by dry rubber bumpers or cowl ledge lacing. Lubricate all rubber bumpers on rails and cowl with silicone rubber lubricant. To correct a persistent case of squeaking or grunting where hood top panel contacts ledge lacing, even when lubricated, cement a 1/16" thick strip of felt to panel where the lacing makes contact.

To prevent hood panel flutter, the rear end of hood panel must have firm contact with the lacing attached to cowl ledge. The hood may be raised or lowered by adjustment at hinges. See Figure 12-6.

b. Preliminary Tightening

Before deciding upon any adjustment to correct hood or fender misalignment it is advisable to check tightness of all attaching screws, and bolts, since a true picture of the correction requirements cannot be obtained when the sheet metal is loose and free to shift.

After all parts are properly tightened inspect fender and hood alignment (subpar. c) and hood alignment (subpar. d). Make all inspections before performing any adjustments because an adjustment at one point will usually alter alignment at other points. The preliminary inspection should determine the adjustments that will produce the best overall alignment of hood and fenders at all points.

c. Fender and Hood Alignment at Front Doors

With front doors closed there should be no metal-to-metal contact between doors and rear ends of front fenders. Check for clearance at frequent points, using a strip of fibre or other soft material 1/32" thick. The spacing between the rear end of front fenders and the shoulder on front edge of doors should be approximately 1/8", and fairly uniform from top to bottom.

Before making any adjustment of sheet metal to provide necessary clearance at points mentioned, first make sure that front doors are properly aligned in the body openings. If fenders and door panel surfaces are not reasonably flush correction may be made by adding or removing shims between the fender and the cowl. See Figure 12-1.

Where spacing between the rear edge of front fender and door is objectionably uneven from top to bottom, it may be necessary to adjust the shims between fender inner skirt and frame, to adjust shims between fender and rocker panel, or to loosen fender attaching bolts and pry between fender and rocker panel. Further adjustment may be made by drawing fender into position and retightening bolts.

d. Hood Alignment Inspection

When the hood is closed and latched, it should bear firmly against the front rubber bumpers on upper tie bar. Height of hood and width of space between hood and fenders should be reasonably even from front to rear. See paragraph 12-3 (a) for fender adjustment and paragraph 12-3 (e) for hood adjustment.

12-3 FENDER, BUMPER AND HOOD ADJUSTMENT

a. Front Fender

If the front end of the sheet metal assembly is too high or too low, resulting in objectionably uneven vertical spacing between the front fenders and doors, it will be necessary to add or remove shims at front support locations. Whenever shims are to be added or removed at the front support locations, it will be necessary to loosen the lower rear attaching bolts at the inner skirt to body. See Figures 12-1 and 12-2. Adjustment of rear edge of the front fender is accomplished by shimming at the fender-to-body attaching points. The fender line should be flush with the rocker panel.

b. Bumper Adjustment

The bumper attaching bolt holes in frame cross member, back bars and bumper face plate are slotted to permit movement of the bumper and permit proper alignment with adjacent parts. See Figures 12-7 and 8. Step assembly on rear bumper of estate wagons should be installed per instruction in Figure 12-17.

c. Removal and Installation of Hood Hinge Springs

1. Support hood in extreme "up" position preferably by chain fall if available.

2. To remove hood spring insert Remover and Installer J-9214 through loop in forward end of spring. Push tool toward rear of car using hinge as a pivot and carefully remove spring from notch. See Figure 12-5.

CAUTION: Care must be used when releasing spring.

3. Push tool forward, causing hood spring to slide clear of hinge.

4. To replace hood spring, insert Remover and Installer J-9314 through loop in forward end of spring. Push tool upward, using hinge as a pivot, and seat spring into notch. See Figure 12-5.

d. Removal and Installation of Hood Assembly

1. Support hood in extreme "up" position.

2. Place folded rags under rear corners of hood to prevent possible damage to fenders.

3. Scribe a reference line along edge of each hinge flange so hood can be replaced in same position.

4. Remove six hood hinge to hood bolts.

5. Lift hood from car.

6. To install, reverse above procedure.

e. Hood Adjustments

1. Rear Height. Rear hood height is determined by special washers between hinge and hood. Removing or adding washers will shift rear of hood up or down with respect to hinge. See Figure 12-6.

2. Rear Tension. Too little tension is indicated if the rear hood area flutters. To increase tension, add special washers between the hood and the hinges at the front bolts. See Figure 12-6

Too much tension is indicated if the rear area of the hood bends as it is closed. To decrease tension, add special washers between the hood and the hinges at the rear bolts. See Figure 12-6.

3. Front Height. This is determined by two adjustable bumpers. See Figure 12-12 and 13. However, the front of the hood may not contact these bumpers unless the hood latch is correctly adjusted as described in Step 4.

4. Hood Latch. Loosen four bolts attaching latch to upper tie bar. Close hood. Hood will align itself in hood lock catch. Raise hood carefully and tighten all four bolts on the panel assembly. Close hood to see if alignment is still all right.

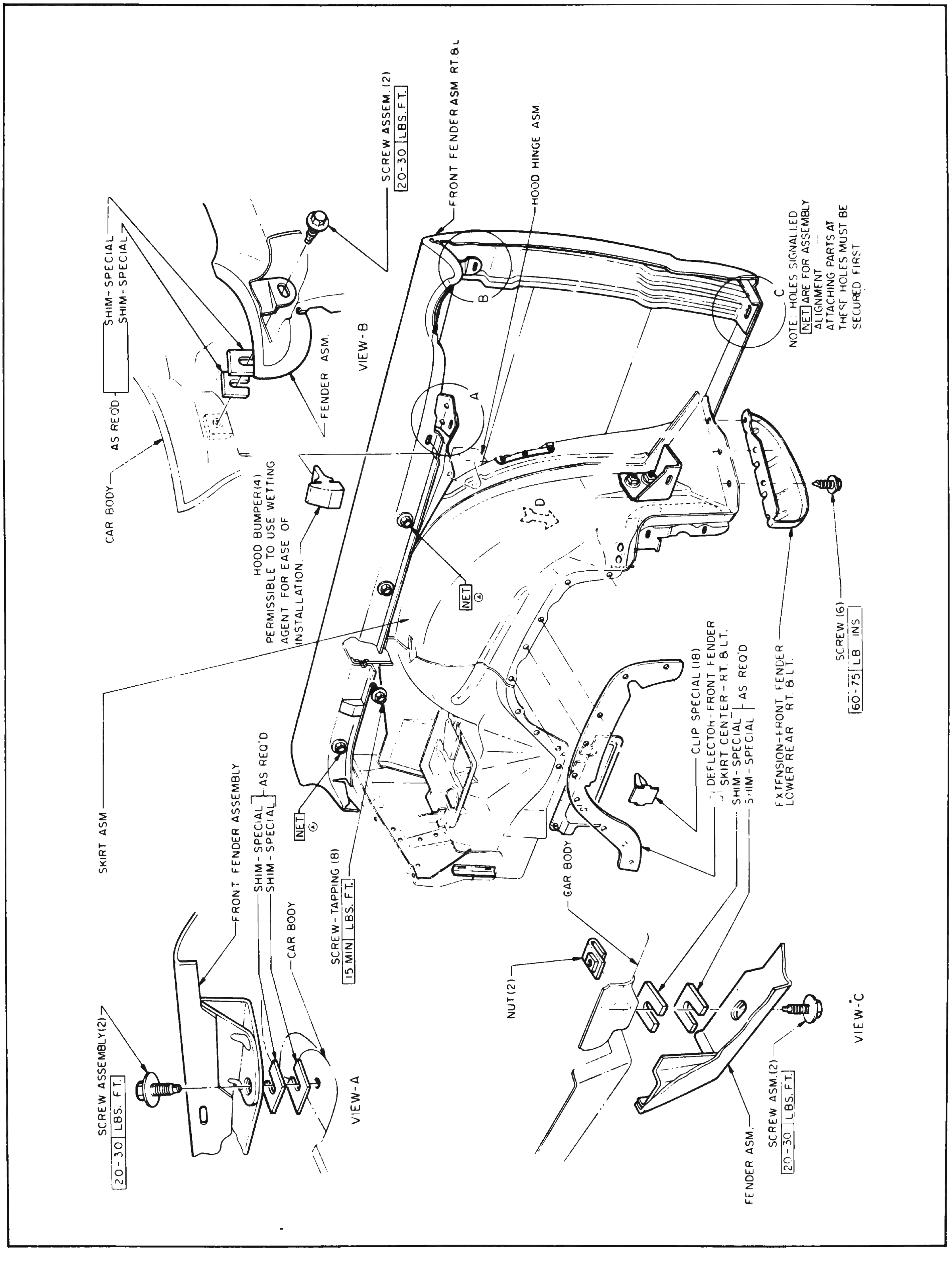


Figure 12-1—Front Fender & Skirt Installation—44-46-4800 Series

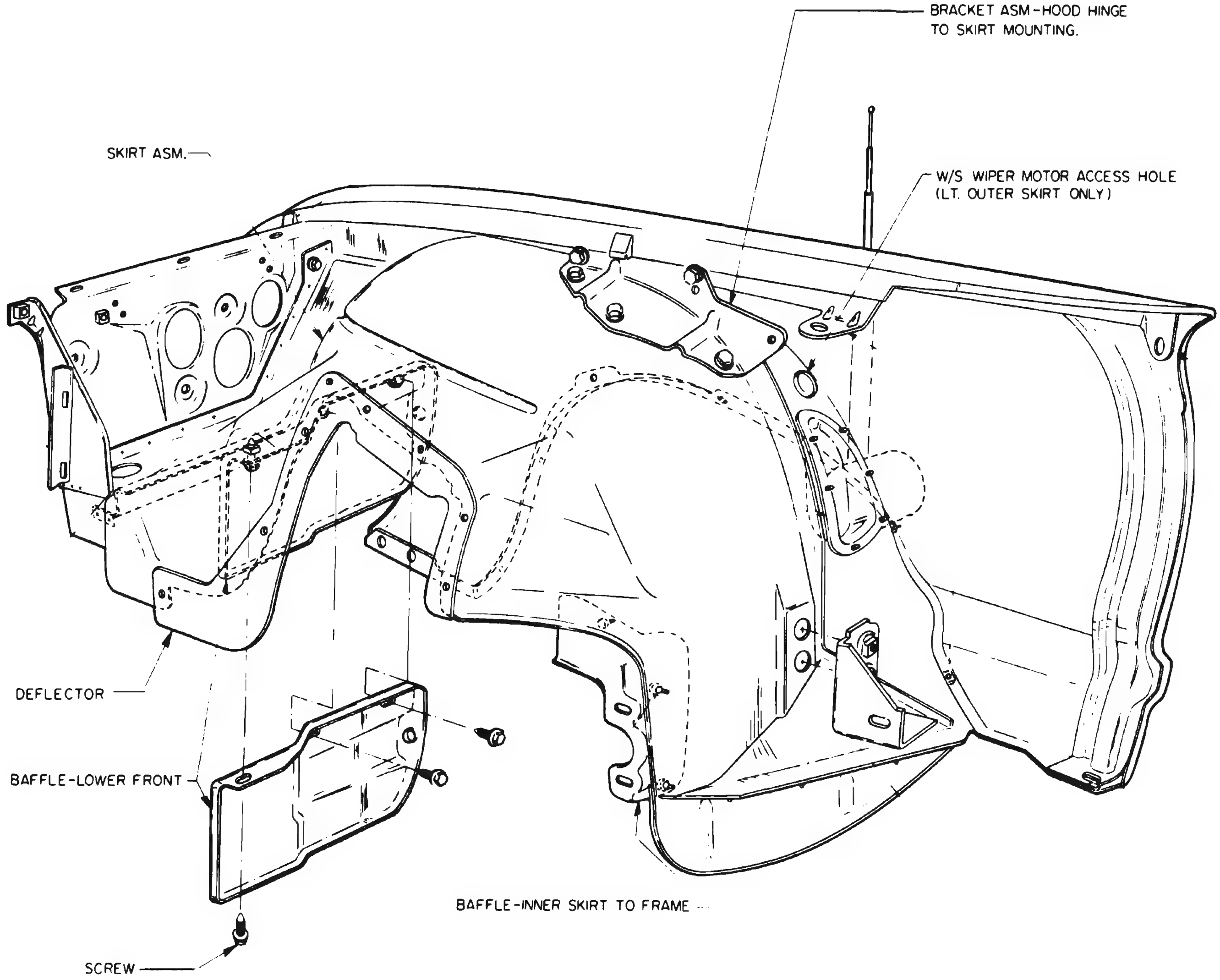


Figure 12-2—Front Fender & Skirt Installation—4700 Series

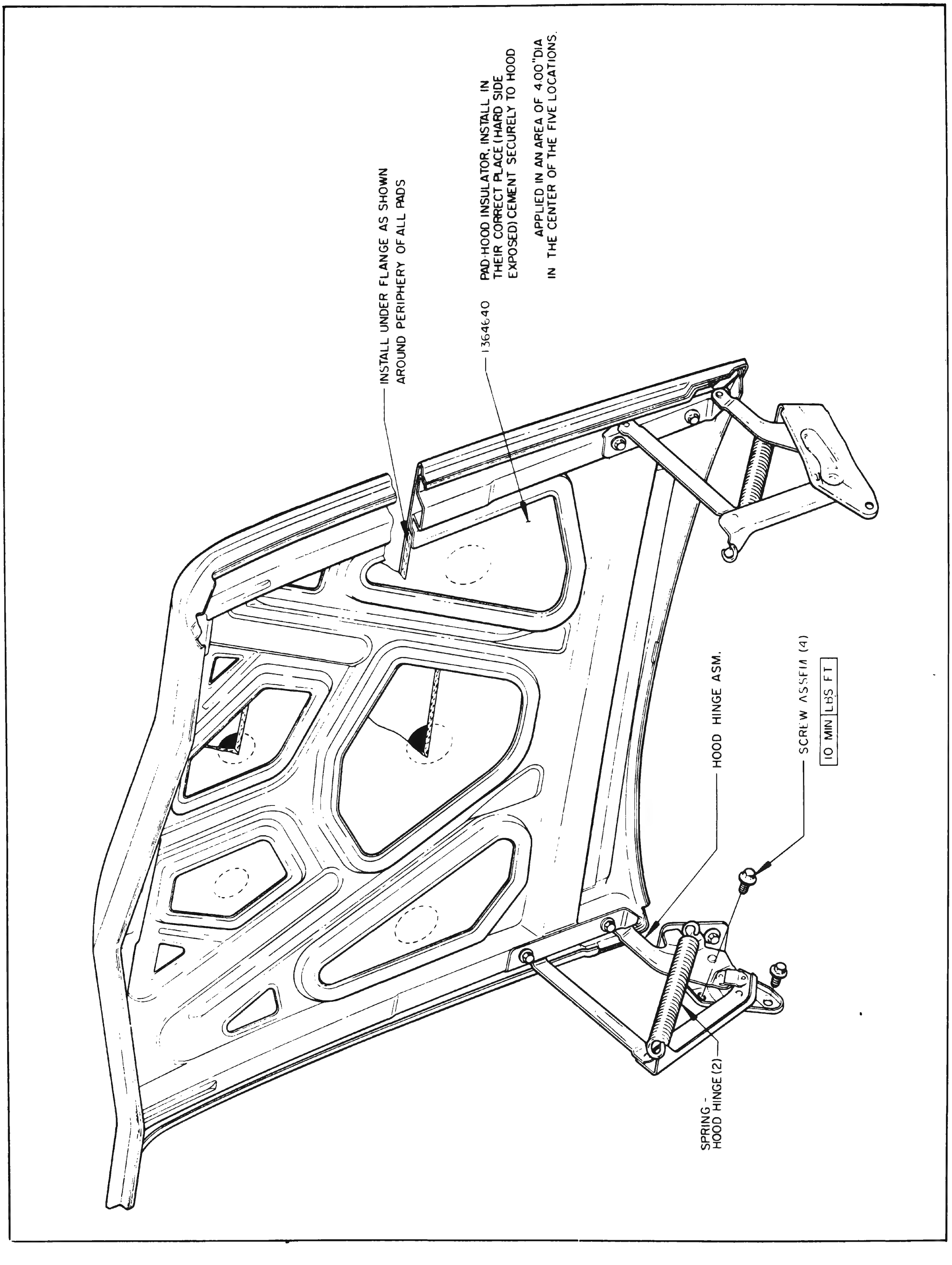


Figure 12-3—Hood Installation—44-46-4800 Series

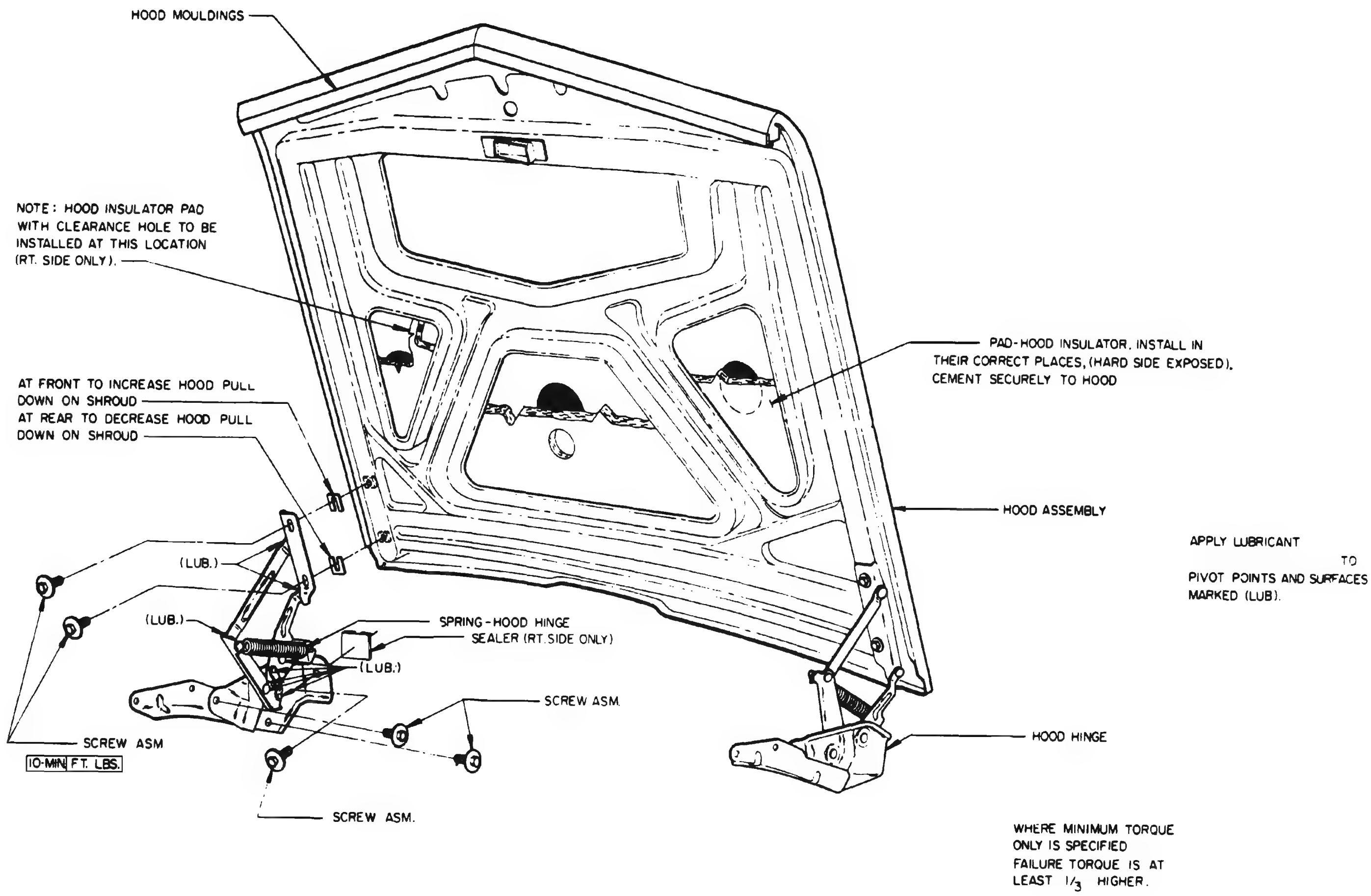


Figure 12-4—Hood & Hood Hinge Assembly—4700 Series

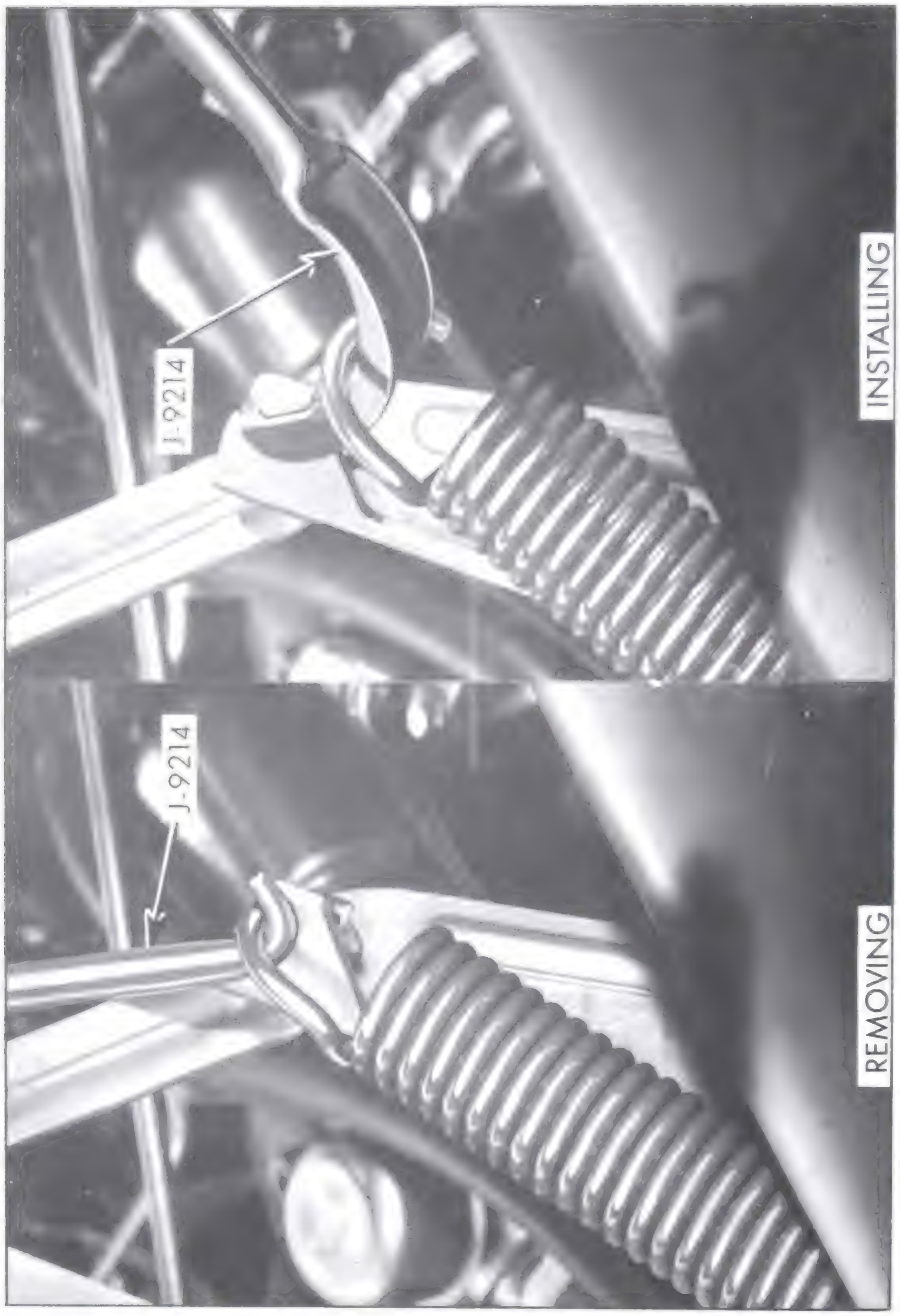


Figure 12-5—Removing and Installing Hood Hinge Spring

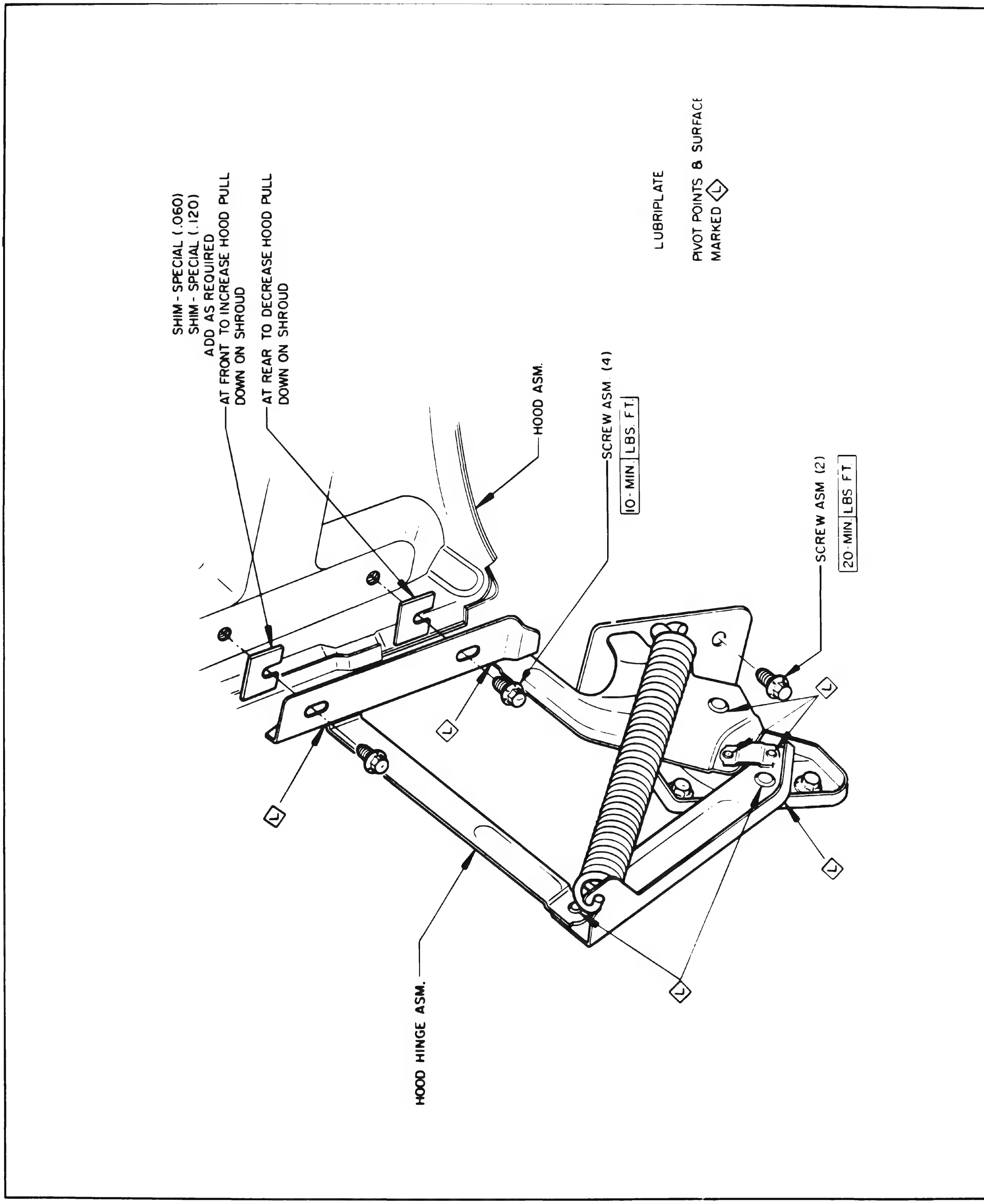


Figure 12-6—Hood Hinge Assembly—44-46-4800 Series

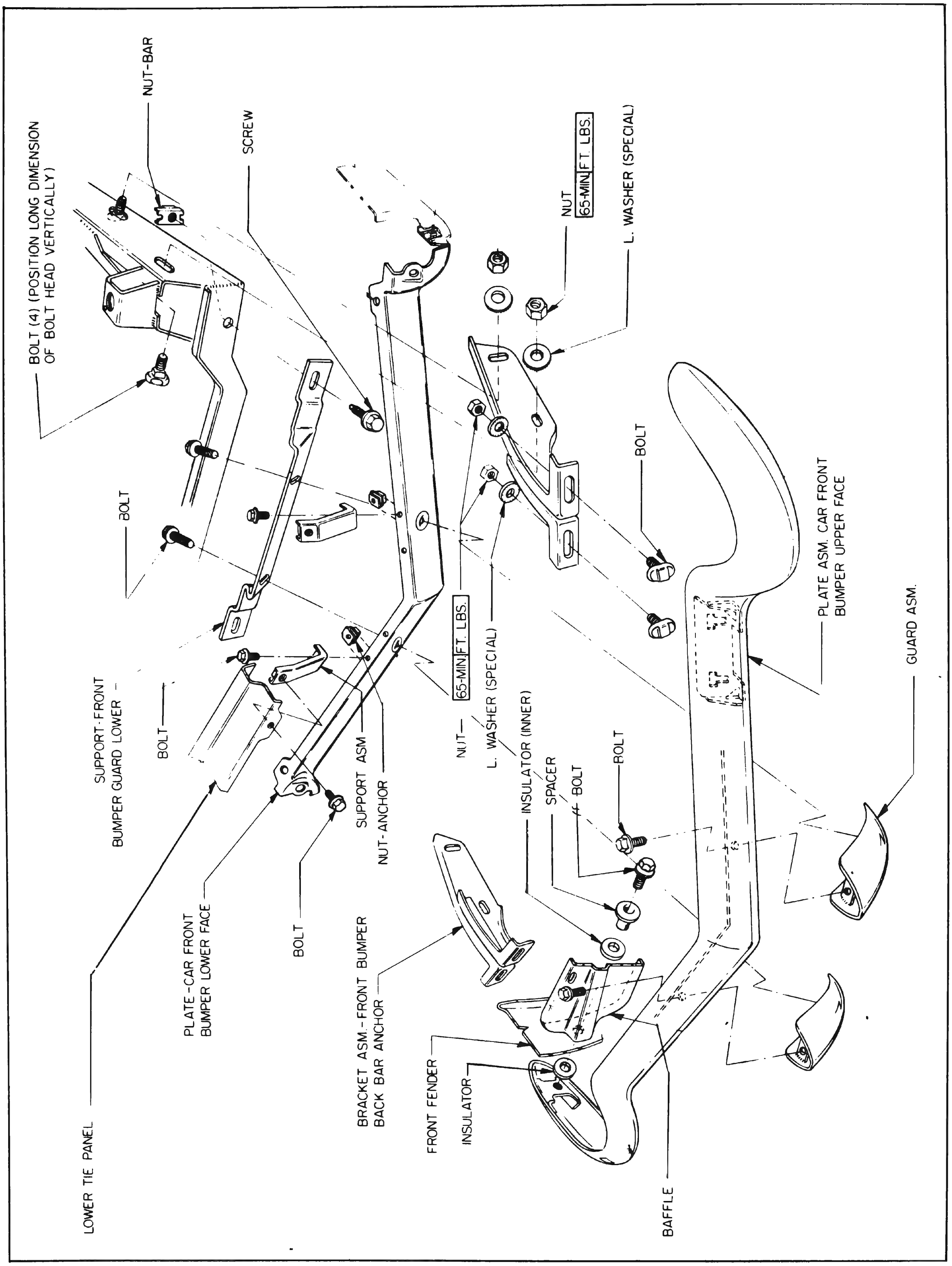


Figure 12-7—Front Bumper Assembly—4700 Series

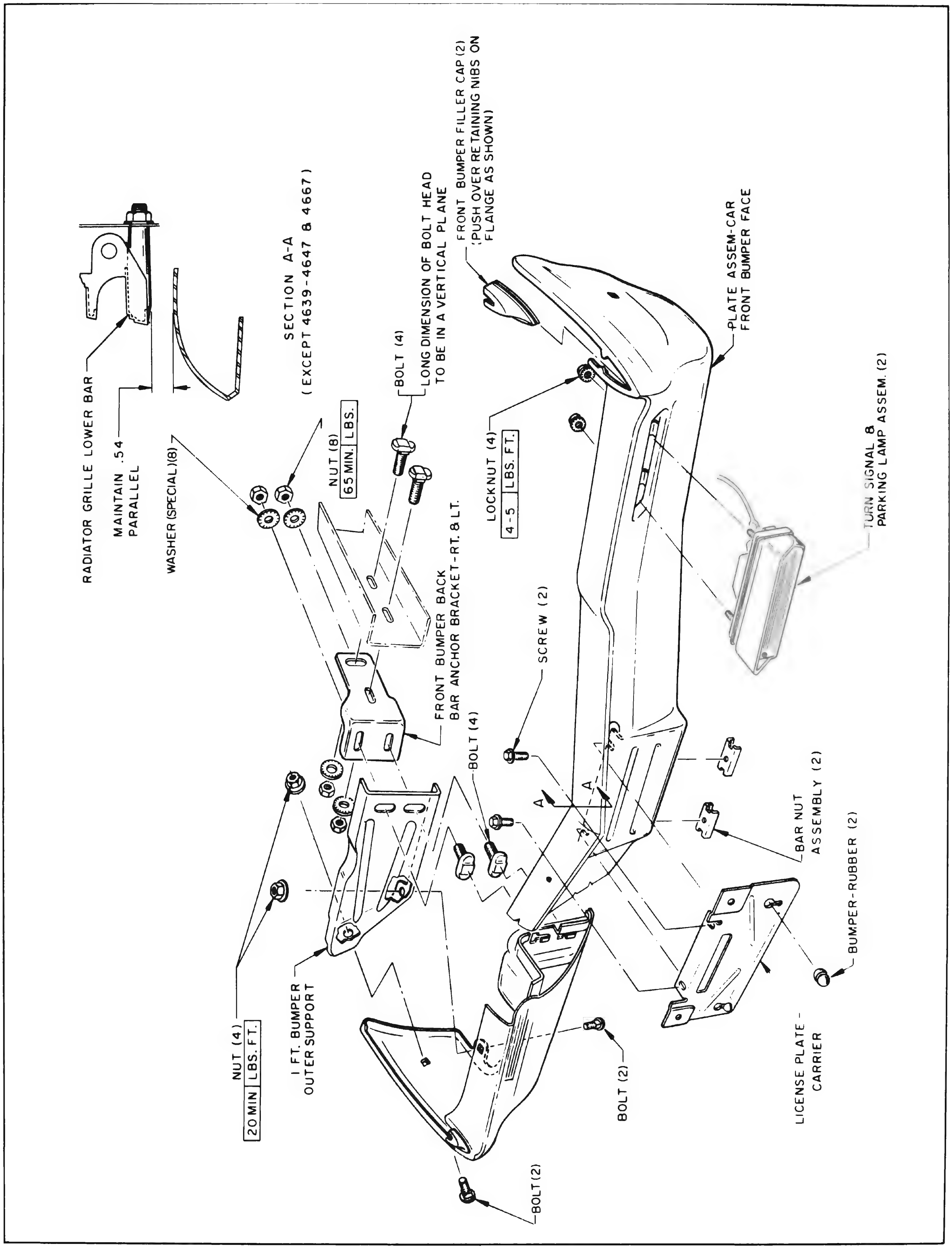


Figure 12-8—Front Bumper Installation—44-46-4800 Series

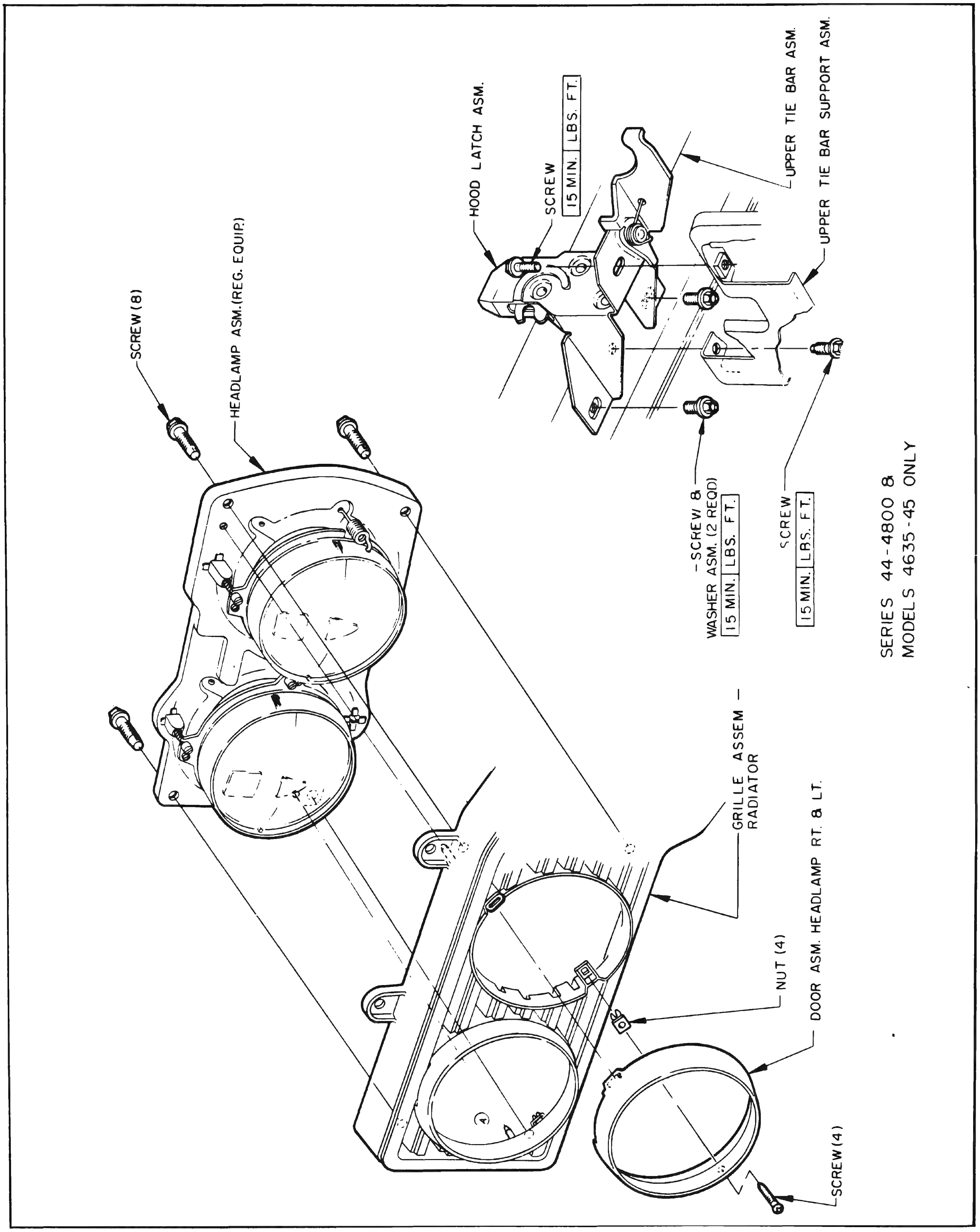


Figure 12-9—Radiator Grille, Headlamp, & Hood Latch Installation—44-4800 & 4635-45 Series

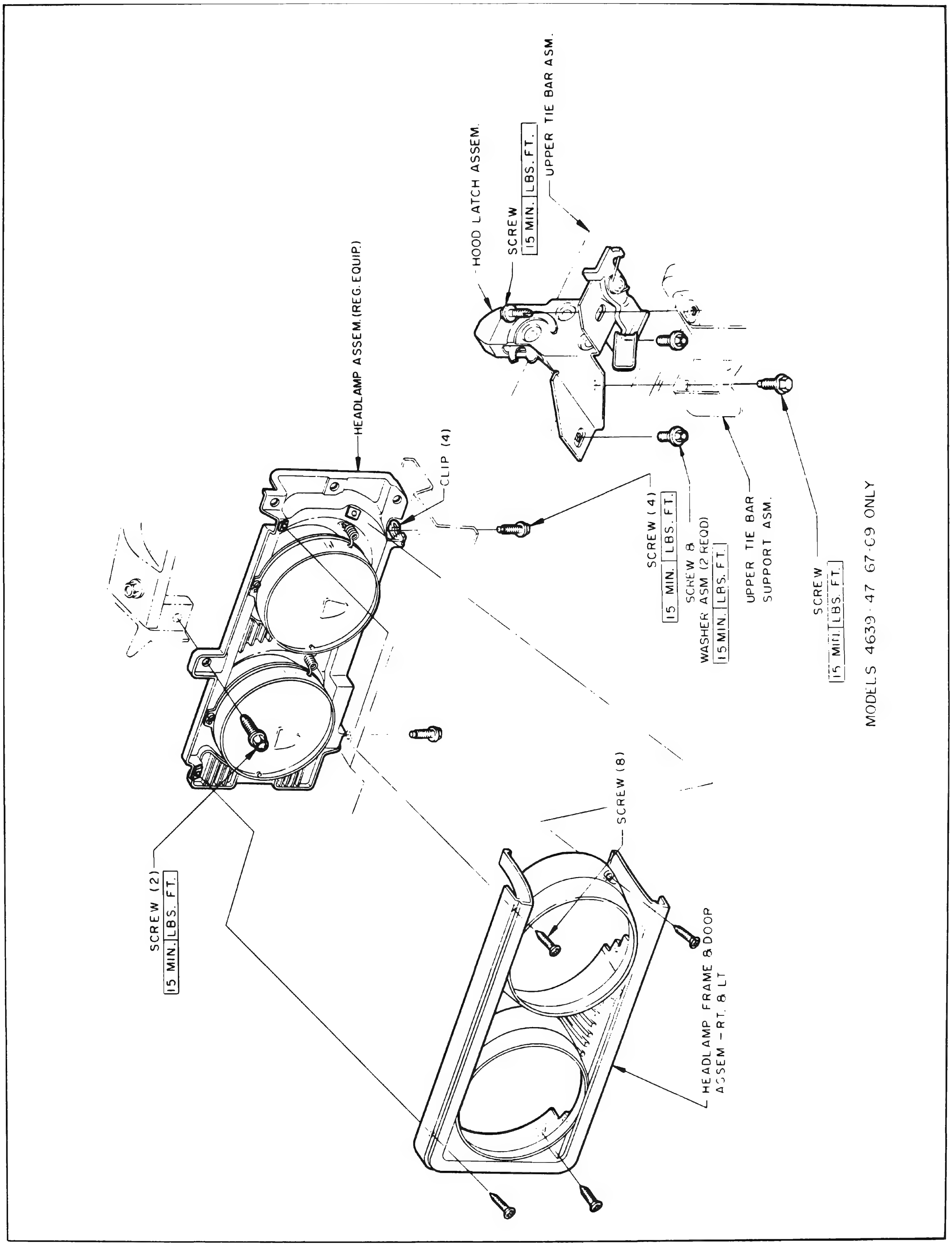


Figure 12-10—Radiator Grille, Headlamps, and Hood Latch Installation—4639-47-67-69 Series

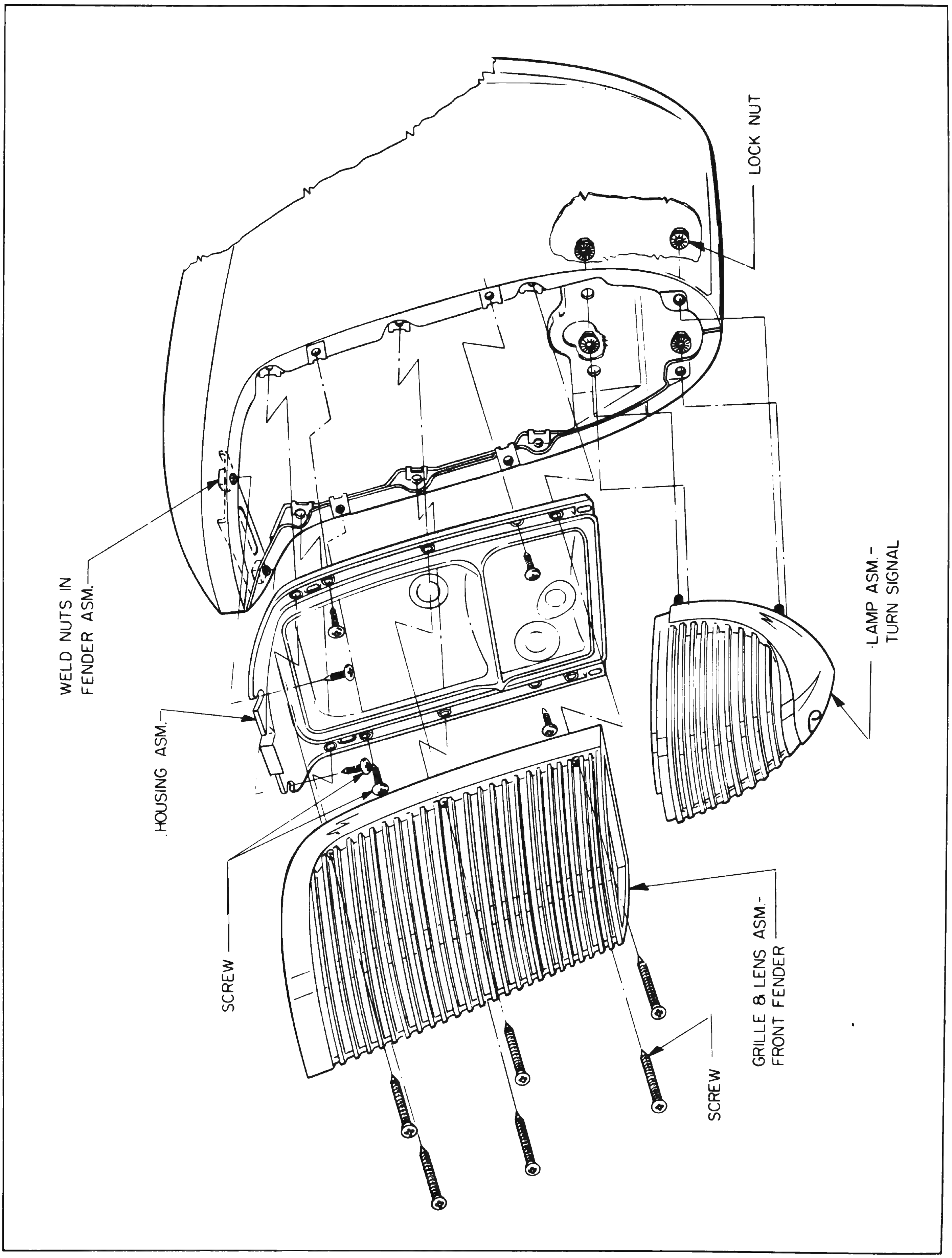


Figure 12-11—Parking Lamp, Cornering Lamp, Directional Signal & Grille Assembly—4700 Series

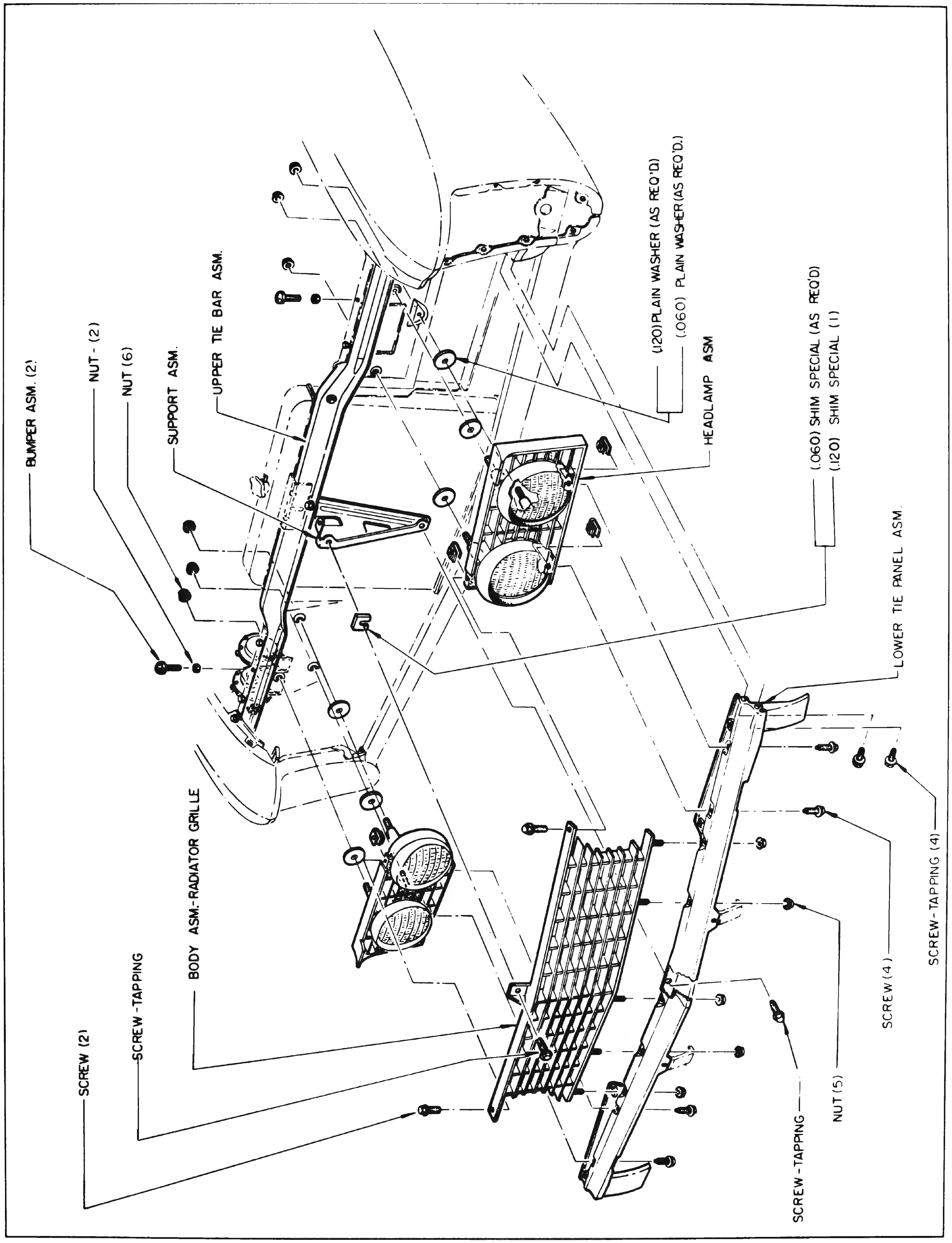


Figure 12-12—Radiator Grille, Headlamps & Front End Installation—4700 Series

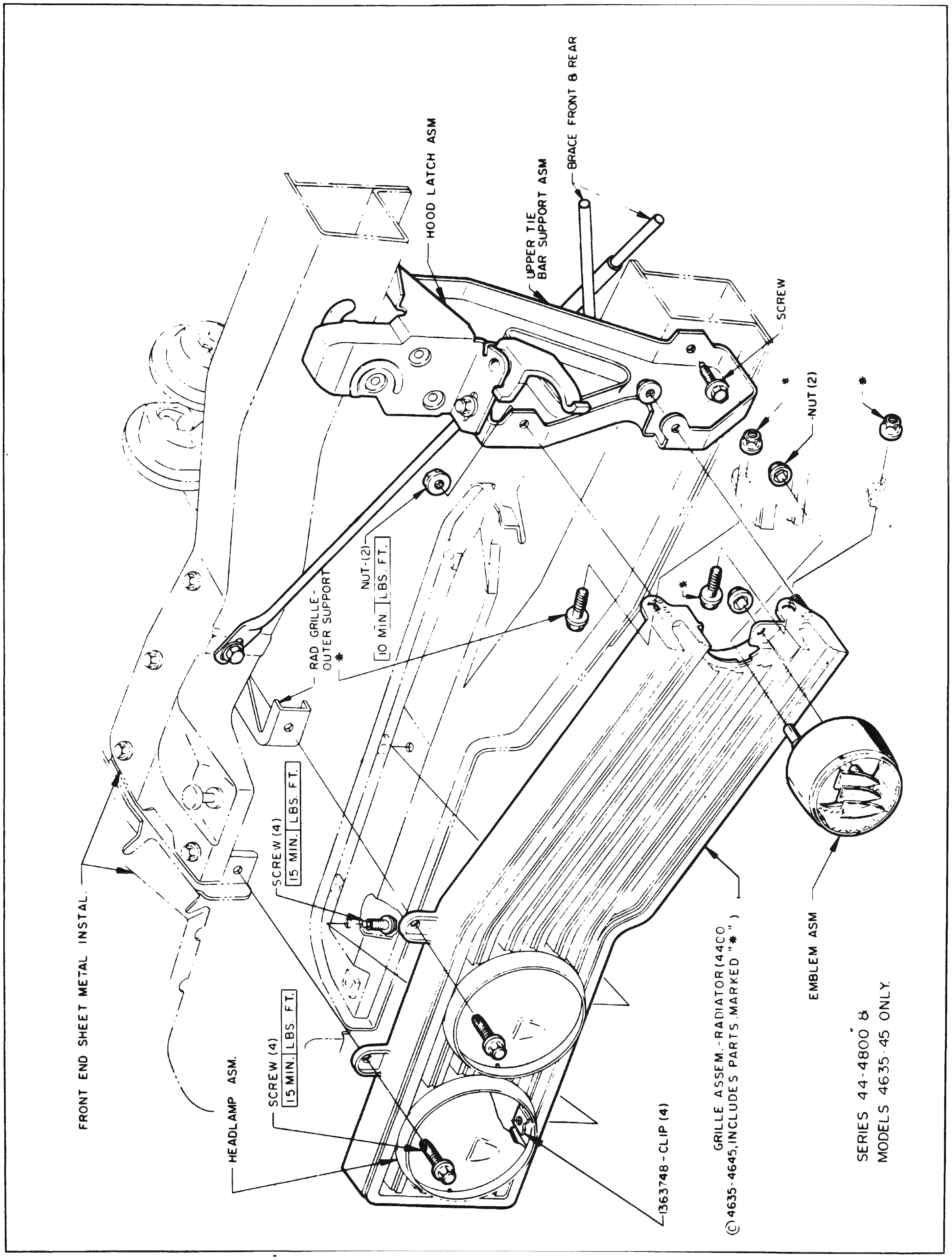


Figure 12-13—Radiator Grille, Headlamps, & Front End Installation—44-4635-4645-4800 Series

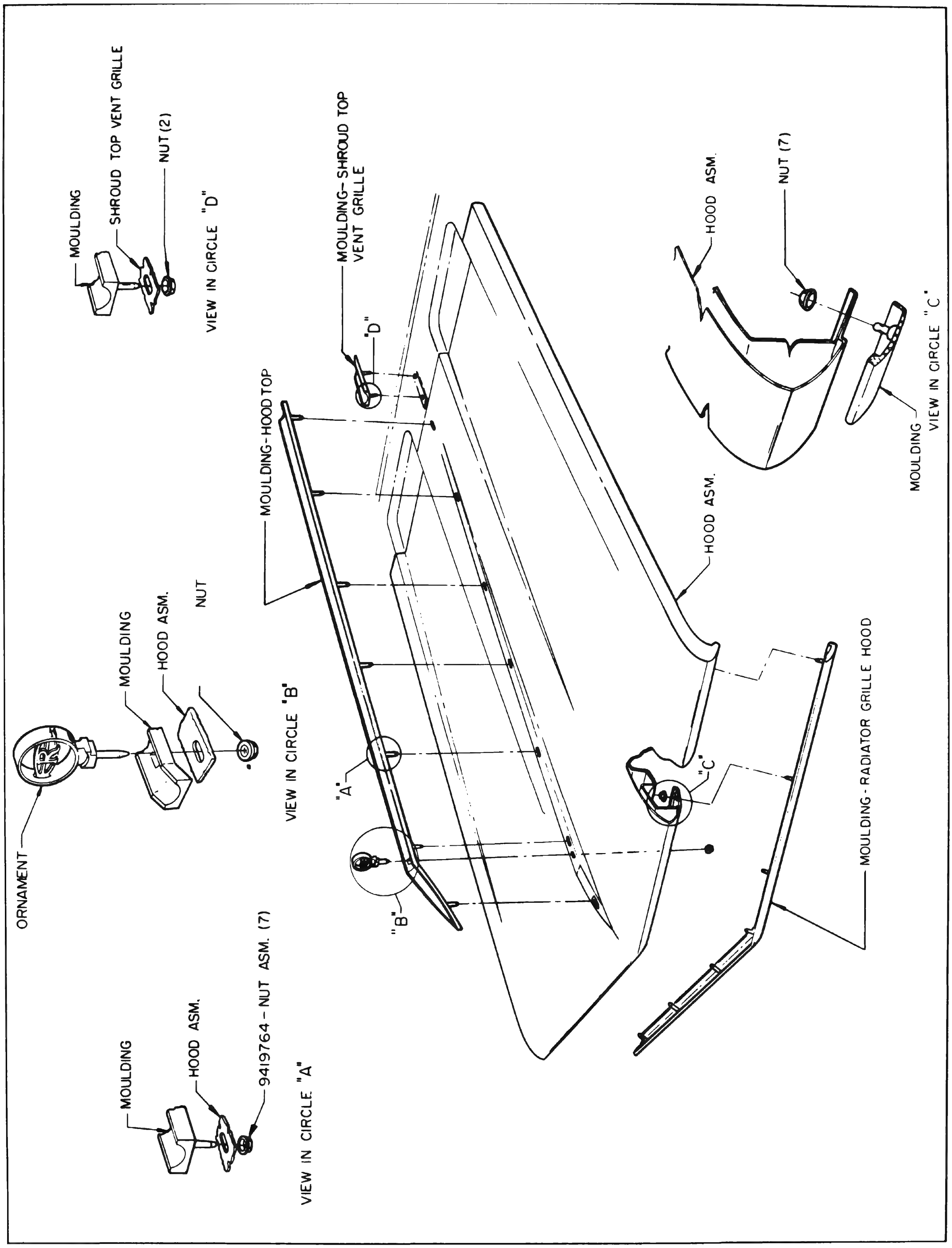


Figure 12-14—Hood Installation—4700 Series

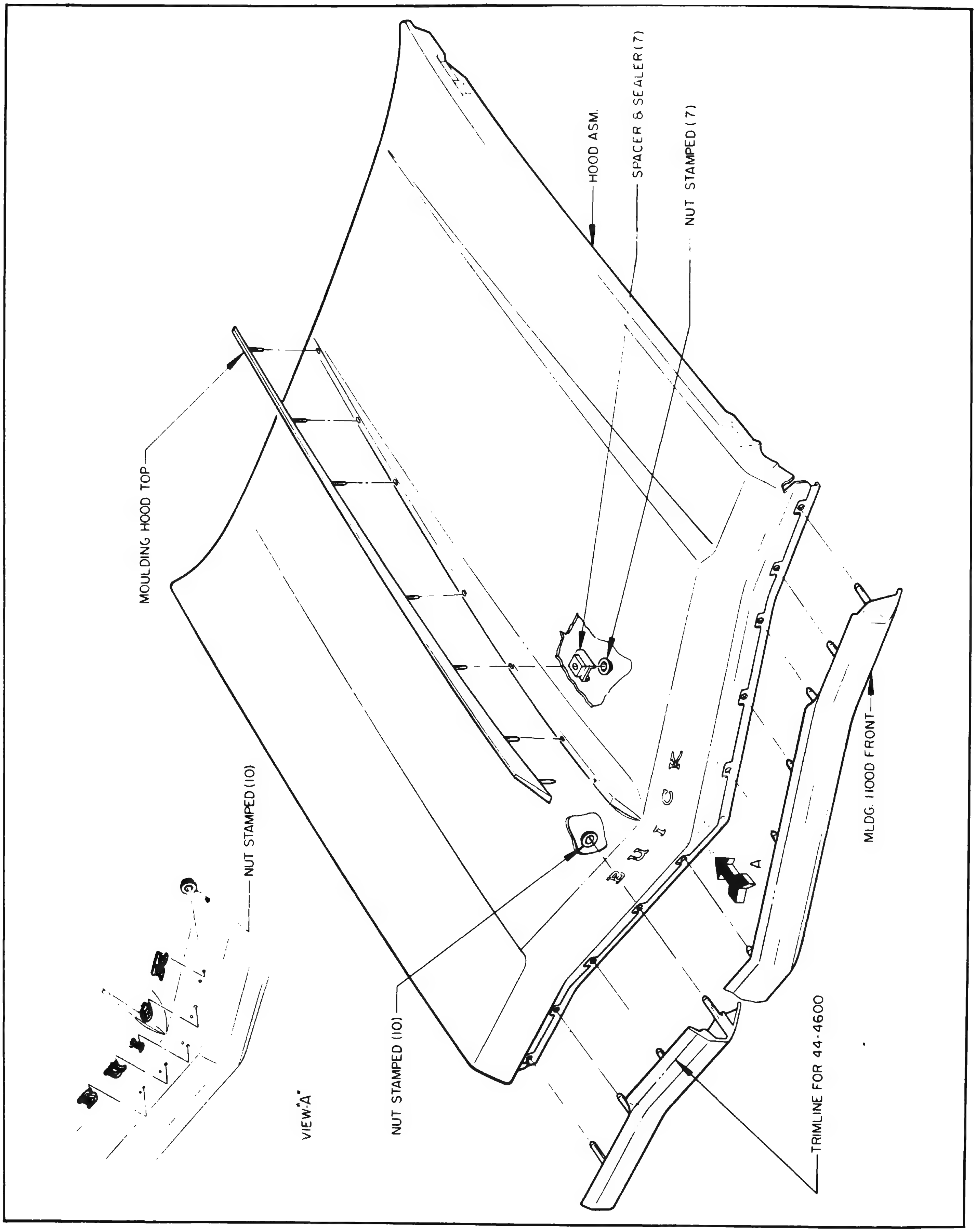


Figure 12-15—Hood Installation—44-46-4800 Series

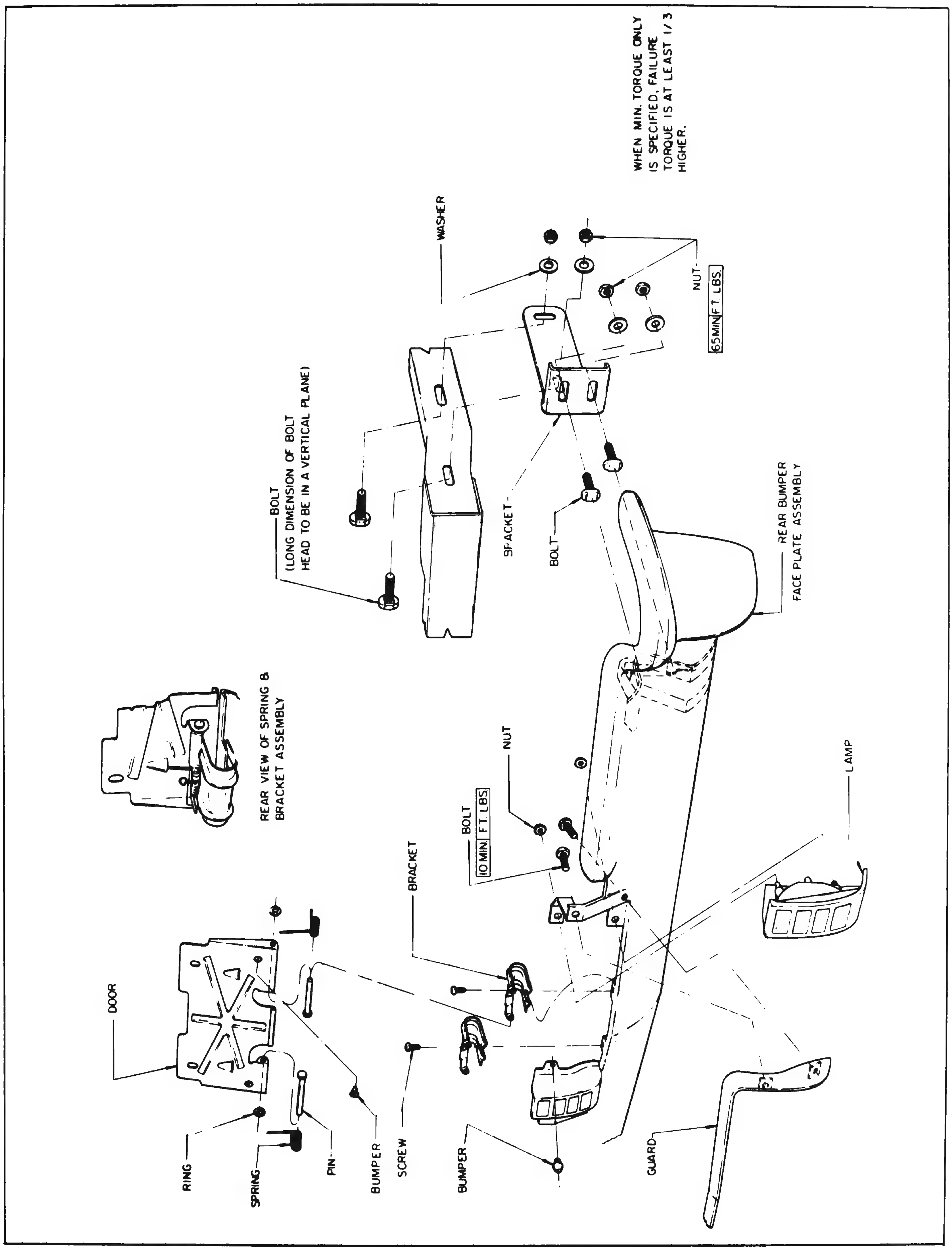


Figure 12-16—Rear Bumper Installation—4700 Series

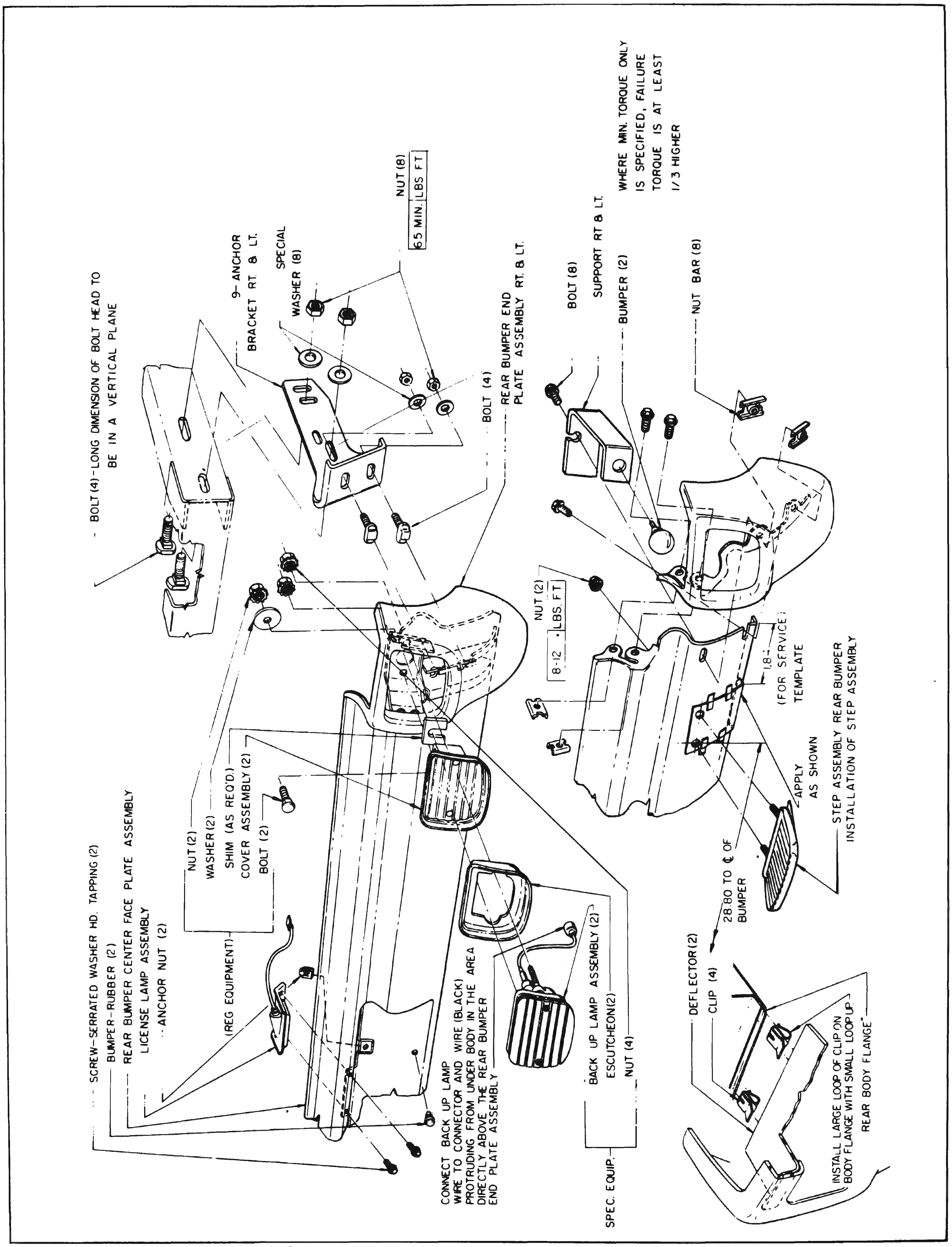


Figure 12-17—Rear Bumper & Back Up Light Installation—4635-45 Series

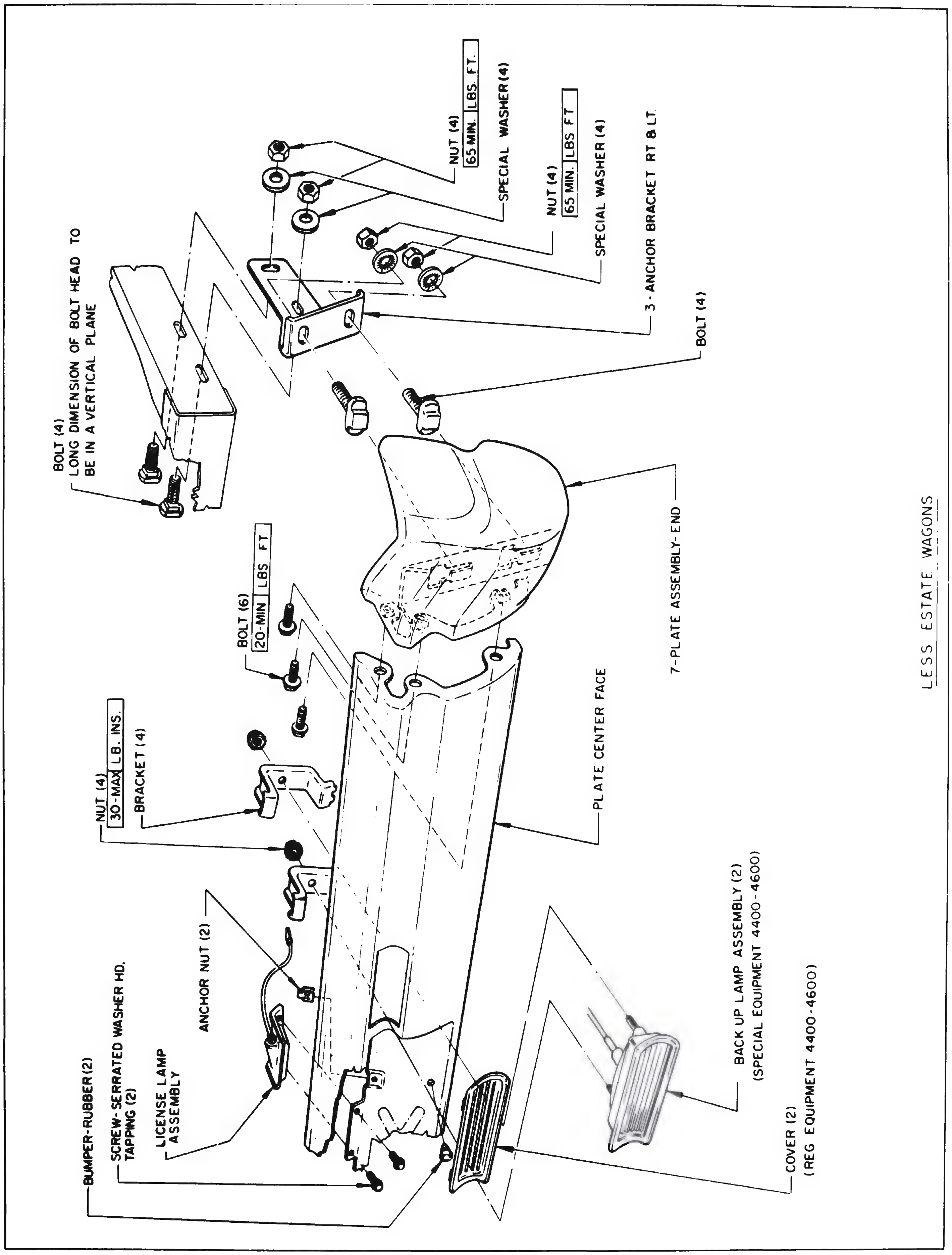


Figure 12-18—Rear Bumper & Back Up Light Installation—44-4600 Series

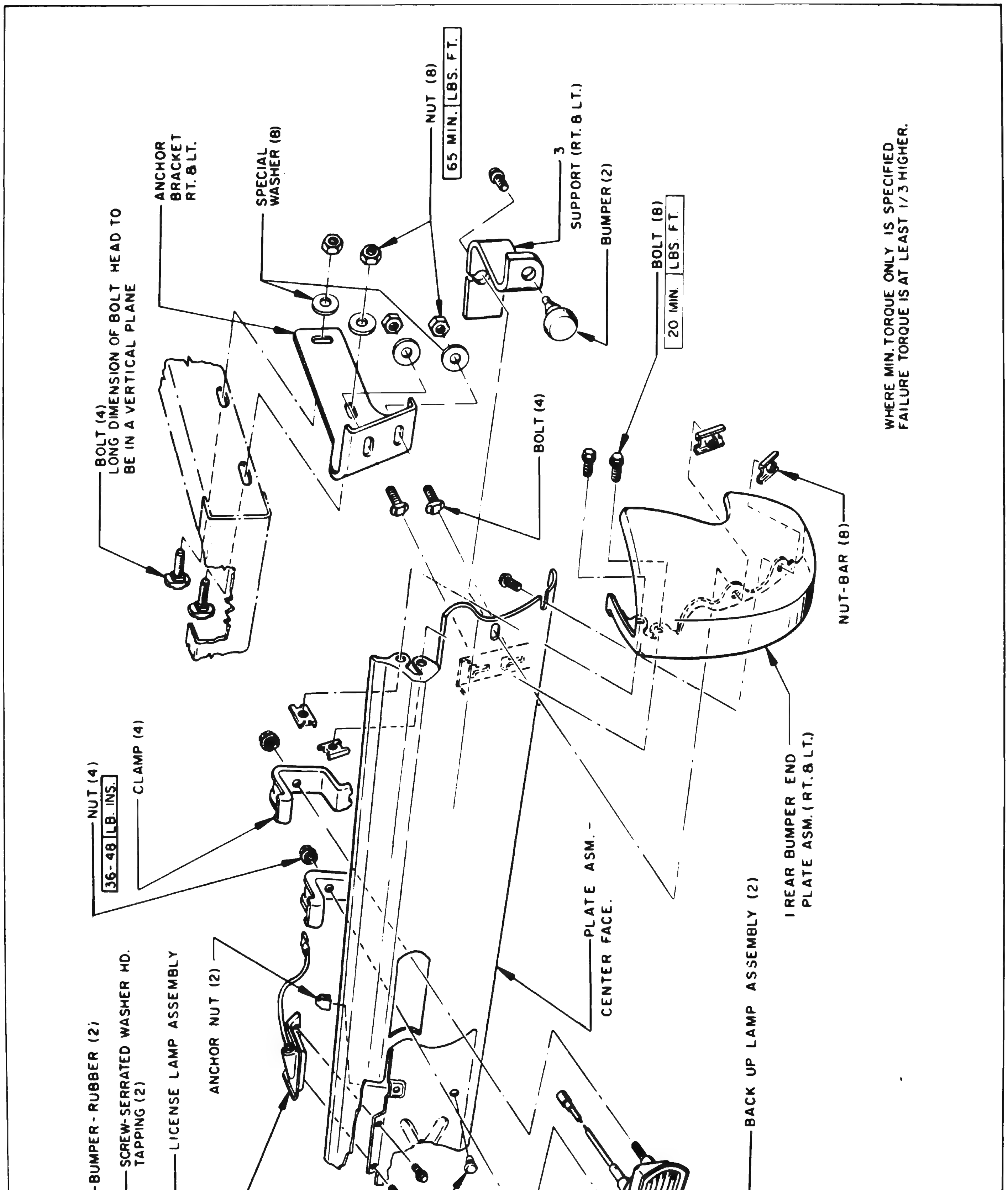


Figure 12-19—Rear Bumper & Back Up Light Installation—4800 Series

GROUP 14

ALPHABETICAL INDEX

A

B

C

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